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Cost Estimating for Jobbing Work

Describing the Organization and Procedure in the Hull Division of the Philadelphia Navy Yard

By J A Furer, Naval Constructor

THE ideal way to estimate the cost of a job is to make a time study of the operations involved, and to build up the total cost therefrom. This is a comparatively simple matter for manufacturing jobs, especially if done by piece work or under a premium system of payment, but is an impracticable method of estimating the cost of repair work for various reasons.

In the first place, no two repair jobs are exactly alike; and a very complete analysis of each job is apt to cost nearly as much as the work itself. Then, too, repair jobs must usually be done by day work, and an output of the workman under this system of compensation corresponding to the possible performance indicated by a scientific time study cannot be expected.

Ship repairs and alterations afford a particularly good example of jobbing work to which the scientific time study method of making estimates is not well adapted. Such estimates have been in the past, and still are, in a great many plants made by the foremen of the various trades. At the best, estimates made in this manner are only good guesses, based on the past experience of the foreman, as he has neither the time nor the inclination to keep extensive records of actual unit costs from which to build up accurate estimates.

By long experience, the practical man can, of course, arrive at a point where he is capable of very shrewd guessing as to the probable cost of a job; but when one hears of a foreman whose estimates made in this manner are invariably correct, it is usually reasonable to suspect that he watches the cost of the jobs closely, and that it is in his power to switch charges from those jobs on which his estimates were low to other jobs so as to come out right.

Certain it is that the establishment which depends entirely on its foremen for making estimates will lose much business, because some of its bids are too high, and will get other business resulting in loss because its bids are too low.

Although minute studies may not be practicable for jobbing work, estimates which are far superior to those ordinarily made by the supervisory force of the production department can be obtained by establishing an estimating section, and by recording actual cost data in such form that it will be readily available for building up future estimates. Industrial managers can still be found who consider the cost of a separate estimating department an unprofitable overhead expense. A very large majority of managers realize, however, that such a department more than pays its way by relieving the supervisory force of the burden of paper work involved in making estimates, and by the more reliable estimates which can be obtained therefrom.

The first thing which strikes the manager in transferring estimating work to a separate department is the paucity of data available for making estimates other than by the guessing method. The foreman, when asked for his data, will generally say that he knows about how much a mechanic and his helper can do in a day, and that he has not found it necessary to accumulate a large amount of unit cost data in order to make estimates. This statement may be quite true in the case of a shrewd foreman so far as the work of that particular foreman's trade is concerned; but as a repair job is seldom confined to one trade only, the foreman, in making his estimate, must either spend considerable time in getting estimates for the other trades from the foreman concerned, or he

FLANGED JOINTS, MAKING, 4" PIPE.

SPECIFICATION	DATE	LABOR		MATERIAL	
Based on cloth inserted rubber gasket. Marking holes & cutting gasket. Setting up bolts.	2-12-11 to 4-15-11				
Average per joint,			70		
Maximum per joint,		1	45		
Minimum per joint,			30		
Units taken from 34 joints, averaging 5.4 bolts per joint. Maximum is cost of a joint in very cramped location on ship. Minimum represents best shop conditions.					

FIG. 1

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guesses at that part of the cost, usually he does the latter as being the easier.

On account of this lack of data, it is impossible to turn over the estimating to a separate department all at once. It is also usually necessary to train the personnel of this department before it can be expected to give good service, because men of the requisite experience and judgment, without further training, will not generally be found available in the establishment.

This was the situation which confronted one of the industrial divisions of a navy yard several years ago. The first step taken was to select two men as the nucleus for the estimating section personnel. It was considered especially important to make good selection to begin with in order not to discredit the work of the estimating section at its inception. The principal qualities looked for in these men were general technical knowledge of the work done by this industrial division of the navy yard, actual working knowledge of at least one trade, good judgment, and the ability to work systematically. The last mentioned quality is especially important in connection with analyzing and recording data of actual cost in such form that they will be reliable and readily available for future use. Even with these qualities, a man must be given considerable experience before he can be expected to become a reliable estimator, because the untrained man is apt not to see all of the work involved in doing a job.

The combination of these qualities can best be found in draftsmen of more or less extensive experience, who have at some time in their careers worked at a trade. Two draftsmen meeting these requirements were accordingly detailed for this work, and have proved excellent selections. With a nucleus of this character mechanics, even if they do not possess all of these qualities, can be added when the volume of the work necessitates additions to the force.

To begin with, the estimating for one shop only was taken over. The ship-fitting work was chosen for this purpose, because the foreman of this shop had in his files more complete and reliable cost data than any other foreman. It is well to begin in this manner rather than with a shop which in the past has used the guessing method, so that the estimating department may be broken in to build up estimates in the correct manner, namely, from unit costs, and will not also slip into the guessing habit.

Data files should be started at once; and such meager unit cost data as may be found in the foreman's office should be transferred to the estimating department. The below-mentioned data files are kept in the estimating section of the establishment referred to.

Unit Operation Costs

These records are kept on 3-in. by 5-in. cards, as shown in Fig. 1. The data on these cards are compiled from analyses of jobs done in the past, elementary time studies, and data taken from the shop route sheets. If a piece work schedule is in effect, the rates should also be kept in this file. Elementary time studies are the most reliable sources of unit operation costs. A specific example will best illustrate the method of obtaining data in this manner.

A particular scarcity of unit operation costs of plumbing and pipe fitting work was found. The records contained, of course, an abundance of reliable data giving the total labor cost of jobs as a whole, such, for example, as the cost of installing plumbing fixtures, replacing corroded sections of piping systems on the various ships, etc. These costs were, however, valueless for making estimates (since the exact duplicate of a previous job is rarely met with in this class of work), because they did not furnish the unit cost of the many operations involved in all kinds of plumbing work, such, for example, as breaking and re-making joints on a particular size of pipe, and in a particular location on a ship.

To provide such data, therefore, a detailed record was kept every day

LINOLEUM, LAYING.

SPECIFICATION	DATE	LABOR	MATERIAL
Large job. Take up old linoleum & lay new. Per sq.ft. Data from J.O.160-D-1/642 - 7728 sq.ft. on gun deck.	4/25/11	.07	.12
Small job. Take up old and lay new. Per sq.ft. J.O.1312-D-1/641 - Commissary issuing room - 94 sq.ft. considerable waste.	5/27/11	.10	.13

Fig. 1

RUBBER, SHEET.

UNIT	SPECIFICATION	DATE	PRICE
lbs	Pure sheet rubber, 3/16"	7/26/11	1 00
"	" " " 1/4"	1/22/12	1 04

Fig. 2

DECK LIGHT, 9".

SPECIFICATION	WEIGHT
Frame, brass,	12 lbs.
Ring, "	15 oz.
8 bolts and nuts,	2 lb.5 oz
Rubber grommet,	2 oz.

Fig. 3

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for several months of the exact work done by each mechanic. This record was checked daily by one of the estimators, and notation made of the surroundings and circumstance s under which the work was done. The data were then classified and analyzed. The maximum, minimum and average costs of each unit were then entered on the cards. Unit costs were obtained in this manner for cutting and threading pipe of all sizes, making and breaking joints, both flanged and screwed, removing and re-setting plumbing fixtures and valves of all descriptions, lead lining piping of all sizes, and the other innumerable details entering into plumbing and pipe fitting work. From these unit costs even a comparatively inexperienced estimator can now build up a reasonably accurate estimate.

An elementary time study made in this manner differs chiefly from a stop watch time study in that it indicates the performance which can be expected on a future job under the existing condition of organization and management. As it is the object of the estimator to build up the anticipated cost of a job from data representing actual working conditions in the plant, time studies made in this manner are much more valuable to him than scientific stop watch time studies.

It will be noted that a column is provided on the card shown in Fig. 1 for the cost of material as well as of labor. The material column is not generally filled out, and is provided only for unit costs where a great variation in the market price of material is not likely, as a separate material cost file is kept. The date of the cost entry is always added, because revisions are constantly being made to keep step with changes in the wage schedule, improved methods of doing work and increased efficiency of the working force.

LABOR				MATERIAL			
TIME	TRADES	ESTIMATE		QUANTITY	KIND	EST. COST	
	SHOP-"K".			16-FT.	2½" IRON PIPE @ .18	2	88
	PLATFORM. 466 LBS. @ .06	27	96	50-LBS.	WROT STEEL @ .02	1	00
	SHOP-"D".			250-LBS.	10LB. PLATE @ .02	5	00
	CASTINGS FOR STANCHIONS. 35 LBS. @ .10	3	50	216-LBS.	3"-3"-.72" ANGLE @ .02	4	32
	SHOP-"C"				RIVETS AND BOLTS.	1	25
	CUTTING AND THREADING 4-PIECES 2½" PIPE @ .40	1	60	43-LBS.	1½" BRASS PIPE 10 FT. @ .16	6	88
	BREAKING & MAKING-8-SCREWED JOINTS @ .20	1	60	84-LBS.	1" " " 48 FT. @ .158	13	28
10-HRS.	MAKE 2 PIPE STANCHIONS @ .44	4	40	35-LBS.	SCRAP BRASS CASTINGS FOR STANCHIONS @ .11	3	85
	SHOP-"G".				MISCELLANEOUS.	1	00
5-HRS.	3"-3" ANGLE FRAME @ .96	4	80		TOTAL FOR ONE SIDE	39	46
12-HRS.	FEET FOR 2-PIPE STANCHIONS @ 1.22	14	64		" " BOTH SIDES	78	92
	SHOP-"Mc."						
4-HRS.	ALTER VOICE TUBE	2	80				
12-HRS.	ALTER JACK RODS FOR WEATHER CLOTH.	8	40		INDIRECT.		
8- "	RELOCATE SIGNAL LOCKERS.	5	60	SHOP	"K" - 27.96 × .45	12	59
16- "	FIT SEMAPHORE TO NEW LOCATION & SECURE	11	20	"	"C" - 7.60 × .40	3	00
8- "	DRILL & FASTEN FEET OF TWO-2½" STANCHIONS	5	60	"	"G" - 19.44 × .85	16	53
	SHOP-"L1"			"	"Mc" - 33.60 × .50	16	80
8-HRS.	3-LABORERS TO HANDLE HEAVY WEIGHTS	6	00	"	"L1" - 6.00 × .35	2	10
	TOTAL FOR ONE SIDE	98	10		FOR ONE SIDE	51	02
	" " BOTH SIDES	196	20		" BOTH SIDES	102	04

FIG. 4—FRONT OF CARD

Unit costs as well as unit times are usually recorded, because the estimator can compile an estimate more quickly from the former than from the latter. The unit cost is merely an extension of the unit time multiplied by the rate of pay of the mechanic or gang doing the work. A brief note giving the source from which the unit was obtained, that is, the previous job, time study, or route sheet data, is entered wherever possible, as this information is very valuable in connection with the investigation of costs that do not agree with the estimates, as described further on.

Material Cost File

As the storekeeping is done by a separate department having offices in a separate building, it is inconvenient for the estimators to obtain the cost of raw material direct from the stock ledgers; and a material cost file in the estimating department, therefore, saves time. Material costs are entered on 3-in. by 5-in. cards, as shown in Fig. 2. These costs are revised monthly, if changes have occurred. When a large quantity of a certain kind of material is needed, the state of the stock in the storehouse is investigated at the time the estimate is made. If the quantity is small it is assumed that the stock on hand will suffice. If material is on hand which does not exactly meet the requirements, but which will answer the purpose, the expediency of using it instead of buying especially for this job is investigated, so as to keep the stock down to the lowest limits possible.

Stock lists of old salvage material recovered from other repair and alteration jobs are also kept on file, so that the use of such material may be specified wherever practicable. The die books showing what fittings can be obtained as drop forgings are also on file in this office.

As many estimates can best be made on the weight basis a file has been compiled of the weight of a large number of fittings and standard material entering into ship construction. This file is especially useful for estimating the cost of castings,

NO. 345-29 ESTIMATE DATE MAY 18 1912

SHIP BIRMINGHAM ITEM NO 10 LETTER C.O.let.4/7/12.

Build semaphore stands on after side of bridge and install semaphores on same. The semaphores are now installed on the bridge and on account of small size of bridge it is too much congested.

J. O. NO.

J. O. WORDING Build semaphore platforms at after end of bridge, port and starboard, as shown on plan 30-E-204. Re-locate signal lockers and after bridge rail to suit new conditions.

ESTIMATE	
LABOR	196.00
INDIRECT	102.00
MATERIAL	79.00
TOTAL	377.00
TIME	12 days

ESTIMATED BY | CHECKED BY | INSPECT. | MATERIAL SCHEDULE | INDEXED

FIG. 4—BACK OF CARD

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shipfitters' work, etc. It is kept on 3-in. by 5-in. cards, as shown in Fig. 3.

Estimate Sheet

The form on which estimates are prepared was especially drawn up to meet the requirements of this establishment. Although the number of estimates made is very large, the size of the individual jobs is usually small. When an estimate for a very large alteration job must be made, it is always broken up into a number of estimates to correspond to the number of job orders that will eventually be issued to cover the work.

PLATFORMS, SEMAPHORE.

SUBJECT	SHIP	No.
Changing location, BIRMINGHAM.	345	29

FIG. 5

It is found that about 95 per cent of the estimates can be prepared on a 5-in. by 8-in. form. This form is shown in Fig. 4. It is printed on heavy paper, and both sides are used. Being printed on heavy paper, the size is particularly convenient, because it can be filed vertically, like a card, and need not be fastened in a folder. When an old estimate is wanted for reference, only that one estimate need be taken from the files.

The estimate is worked out in detail for labor and material on the back of the form. Pasters are added to the back in case there is insufficient room in the space available. The greater convenience of using a small, compact form rather than a larger form more than compensates for the trouble of attaching additional sheets to the small percentage of estimates which cannot be entered in the space available. The percentage of indirect expense which is to be used for each shop is furnished to the estimating section from time to time as changes are made by the accounting department, and is applied to the direct labor as shown in the figure.

The estimate is summarized on the front of the form, and the proposed job order wording is also entered, together with a brief of the correspondence which inaugurated the estimate.

Comparison of Actual With Estimated Cost

The actual cost of every completed job summarized by shops is sent to the estimating section, and is compared with the estimated cost. These comparisons serve not only the purpose of checking up the accuracy of the estimators, but frequently bring to light errors in cost keeping and inefficiency or carelessness in the shops.

A monthly report is made of the percentage variation of the estimated costs from the actual costs. This comparison is also made separately for the work of each estimator, and is a reasonably fair measure of the estimator's efficiency. This comparison also stimulates the estimator to investigate wherein he went wrong in building up the anticipated cost of the jobs. Disagreement between estimated costs and actual costs may, of course, be due to either of two causes or both combined, namely, inaccurate estimating or failure on the part of the production departments to duplicate the output indicated by the unit costs used in making the estimate.

Cases of discrepancies are first investigated by the inside superintendent to ascertain whether or not the estimate was at fault. If the estimate checks up correctly and the actual cost is low, the unit costs on which the estimate was based are examined and revised if the circumstances under which the work was done warrant such revision.

If the estimate checks up correctly and the actual cost is high, the matter is turned over to the outside or shop superintendent for investigation, together with the data of previous performances on which the estimate was based. The estimating section becomes in this way a very valuable asset to the management in locating inefficiency in the production departments, because tangible and reliable data are available on which to base investigations of excessive costs.

Index of Estimates

The estimates are carefully indexed on 3-in. by 5-in. cards, as shown in Fig. 5, so that they can be readily located in connection with making future estimates. A previous estimate on a similar job is always valuable, especially in the case of repair work, even if the jobs are not identical, because it helps to check the new estimate, and may bring to the estimator's attention some minor part of the work which might otherwise be overlooked.

Diesel Ship for South American Service

The Howaldswerke, Kiel, has recently completed for the Hamburg-South American Steamship Co., Hamburg, the trans-Atlantic twin-screw cargo-boat Monte Penedo, which is propelled by two-cycle crude oil engines. Her principal dimensions are: Length, 350 ft.; breadth, 50 ft.; depth, 27 ft. Her gross registered tonnage is about 4,000 tons; she has a carrying capacity for 6,500 tons, and her speed fully loaded is about 10½ knots. The propelling machinery consists of two reversible, 4-cylinder, 2-cycle Diesel-Sulzer crude oil engines of together about 2,000 I. H. P. The auxiliary machinery includes a 50 H. P. Diesel engine-driven dynamo; an air compressor driven by a similar engine; an accessory steam-driven air compressor; a condensing and water cooling plant. The auxiliary machinery is steam-driven with the exception of the steering gear, which in the open sea is operated by heated compressed air; the necessary steam is raised in an oil fired boiler.

SEMAPHORE PLATFORMS.

SUBJECT	SHIP	No.
Changing location, BIRMINGHAM.	345	29

FIG. 5

The steamer Dakotan, building for the American-Hawaiian Steamship Co. at the Maryland Steel Co.'s yard, Sparrows Point, Md., was launched last month. The Dakotan has a length over all of 429 ft., beam 53½ ft. and depth 29½ ft., and is the second of eight freighters contracted for by this company to be launched.

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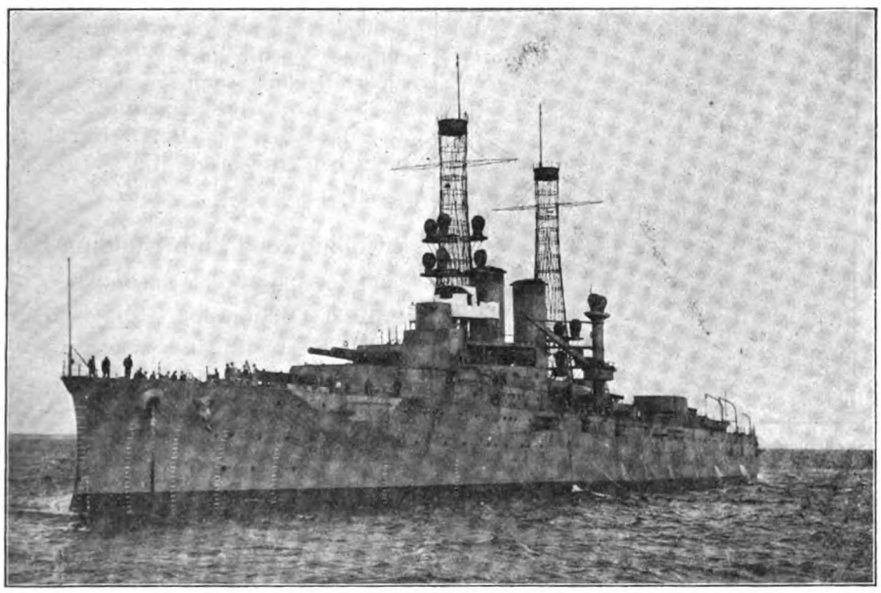
Trials of Battleship Wyoming

She Has Established Herself as the Fastest Super-Dreadnaught Type in the Navy

THE battleship Wyoming, built by Cramps, Philadelphia, has established herself as the fastest of the super-dreadnought type in the United States navy. She underwent her trials during the latter part of July.

Leaving League island navy yard at 11:00 a. m., Monday, July 15, she steamed down the river to Deep Water point and anchored at 2:20 p. m., left Deep Water point 10:25 the following morning and proceeded to the Delaware bay, where compasses were adjusted and main engines slightly toned-up and everything put in readtract for 20.5 knots per hour, that 280.2 revolutions per minute would be required. On one of the highest speed runs, the maximum number of revolutions per minute made by the propellers were 333.61, which by far exceeded the contract requirements.

Until the Wyoming made her highest speed runs her sister ship, the Arkansas, built at Camden, N. J., held what was considered a world's record for this type of warship, her record being 21.153 knots, while that of the Wyoming for her average of the highest speed runs was 21.323 knots.



BATTLESHIP WYOMING

iness for a series of unofficial speed runs en route to the trial course off Rockland, Me. Arriving at Rockland Thursday at 7:45 p. m., work was commenced on the final adjustments of turbine rotors, consisting of increasing and decreasing the various dummy clearances as necessary for the efficient and economical operation of the installation and design.

Upon the completion of the above, the specified standardization runs over the measured mile course were started, making three runs each, at 10, 12, 15, 17.5, and 20.5 knots; and then five runs at her highest speed, making a total of twenty-three runs. These runs were completed Friday, July 19, with considerable wind blowing.

The curve constructed from these runs showed that to maintain the required speed as specified in the con-

Saturday the four-hour full power trial was started, during which the Wyoming on the second hour of this trial developed the remarkable speed of 22.045 knots, which is declared by naval experts who were aboard to be the fastest time ever made by any battleship or dreadnought in the world of such tonnage and carrying twelve 12-in. guns in her main battery. The average speed for the four-hour full power trial was 21.21 knots.

Particulars of the Wyoming

Finishing this run, fires were cleaned, ashes put overboard, and ship reweighted at sea, and brought down to the trial displacement and the 24-hour, 19-knot speed, coal and water consumption trial was started. Following this the ship was again reweighted, etc., and the 24-hour, 12-knot speed, coal and water consumption test was started and finished 2 p. m., Monday, July 22, when the severe backing tests and the tactical steam steering diameters of the ship were taken.

The two-hour trial of fuel oil and coal combination terminated the government tests, when the Wyoming started for the Delaware Capes. The following are the general dimensions of the Arkansas and the Wyoming:

	Ft.	In.
Length over all	562	
Length between perpendiculars	554	
Length on load water line	554	
Extreme beam (beyond armor)	93	2⅜
Beam on load water line	92	10¼
Designed draught (mean)	28	6
Displacement at designed draught, tons	26,000	
Load water line displacement per inch, tons	88.4	

The hull was designed by the bureau of construction and repair of the navy department, on lines similar to those of the Florida and Utah, with high freeboard forward which insures better seaworthy qualities than the previous types of dreadnoughts built by foreign nations. Steam is furnished by twelve Babcock & Wilcox water tube boilers. The boilers are designed to be combination coal and oil burning, and contain the necessary triple balance between oil, coal and air supply. The satisfactory results obtained from the two hour trial clearly demonstrated the possibilities to be derived from the adoption of oil, as the exclusive fuel for battleships. Ships fitted for burning oil alone, will have to have the furnace volumes greatly increased should the same system of air admission remain.

The saving in fireroom weights and the decrease in the length of the space required for the boilers are predominating factors, which greatly favor the exclusive use of oil for the fuel of battleships.

The capacity of the boilers of the Wyoming are such that all steam machinery can be run at full power with an average air pressure in the ash-pits of not more than 2 inches of water. All the pressure parts of the boiler are made of open-hearth steel plate, the tubes of cold drawn seamless steel with no screw joints exposed to the fire. They are fitted in groups of four, in watertight compartments. Two smoke pipes take the waste gases of combustion, each with an area of 104 sq. ft., and

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are 91 ft. above the grates.

The general boiler dimensions are as follows:

	Ft.	In.
External height	13	10⅞
External length	12	3¾
External width	20	¾
Number of furnaces in each boiler.	1	
Number of headers in each boiler..	31	
Grate surface, square feet	119	
Heating surface, square feet	5352.83	
Ratio of grate to heating surface	1:44.98	
Length of grates, feet	7	
Width of grates, feet	17	
Per cent of air space in grates	49	
Designed working pressure	210	
Boiler test pressure	315	

Each boiler has the following tubes:

Number	1,100	31	2	31
Thickness, B. W. G..	8	6	6	6
Outside diameter	2	4	4	4
Length as fitted, inches	98	98	95¼	76

The Peabody burner was used in the oil burning trial, along with the closed fire room system of forced draft, all blowers being driven by electric motors; twelve in all, limited to 1,200 R. P. M.

Machinery Particulars

The main engines consist of Parsons marine steam turbines, eight in number arranged on four shafts. The cruising turbines are fitted on the inboard shafts along with the low pressure ahead and low pressure astern. This astern turbine is incorporated in the same casing as the low pressure ahead turbine. On the outboard shafts are fitted the high pressure ahead and astern turbines, entirely separate. With this arrangement for speeds up to about 15 knots, steam is admitted into the high pressure cruising turbine, and after finishing work in this engine exhausts into the steam supply of the intermediate cruising turbine, from thence to the high pressure ahead turbines on the outboard shafts and finally to, and through the low pressure ahead turbines on the inboard shafts to the main condensers.

The following are the turbine cylinder and rotor dimensions:

	Diameter of cylinder. In.	Diameter of rotor. In.
H. P. cruising	74½	73
I. P. cruising	74¾	72
M. H. P.	76¼	74
Ahead L. P.	111½	101
	Number of expansions.	Number of rows.
H. P. C.	3	60
I. P. C.	3	54
M. H. P.	6	78
A. L. P.	6	39
Longest length of blading		13½ in.
Shortest length of blading		¾ in.

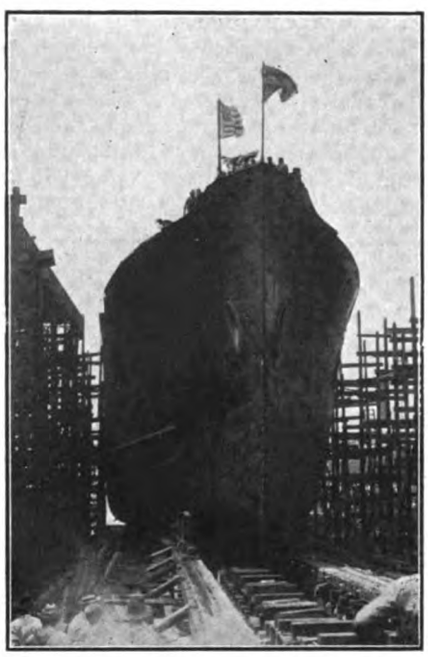
The designed I. H. P. was 28,000 for a speed of 20.5 knots per hour, and during her trials as much as 33,000 S. H. P. was recorded by the torsionmeters.

The New Orleans Steamship Co., New Orleans, La., has been organized with the following officers: S. D. DeMilt, president; A. R. Lafonta, vice president; Frank A. Daniels, secretary-treasurer.

Clyde Liner Lenape

The steamship Lenape, now under construction at the Newport News Ship Building & Dry Dock Co.'s yard, at Newport News, Va., was launched on Aug. 17 and will go into the service of the Clyde line before the close of this year. Miss Margaret Stone, of Marion, Mass., daughter of Galen L. Stone, one of the owners and directors of the Clyde Steamship Co., was sponsor.

The Lenape, like all the Clyde line ships, is an Indian name, and



THE LENAPE LEAVING THE STOCKS

comes from the Indian tribe which inhabited the country surrounding the Delaware water gap.

The Lenape marks an era in point of size and speed and accommodations, in coastwise service. She will have dimensions of an even 400 ft. in length, 50 ft. beam and a depth of 30 ft. The vessel has been built under the American bureau of shipping classification and will be Class A-1, and is of steel construction throughout with freight carrying capacity of about 5,000 tons and a displacement of 7,000 tons; speed 14 knots. She will have three passenger decks. Appointments for passengers and interior finish will be of the best and finest in American coastwise ships.

The Lenape will be the largest of the Clyde line fleet, and in addition to this she differs in some respects from the other ships, being bridge enclosed amidships for the first passenger deck, above which will be a continuous promenade deck.

The propelling machinery consists of four Scotch boilers, fitted with heated forced draft, one triple expansion engine of about 4,000 horsepower, together with all auxiliaries and in addition, a refrigerating machine for steward's cold storage. There will be accommodations for about 350 passengers, consisting of first class and steerage. She will have ample boat and life-saving equipment, with boat capacity for all the passengers and crew.

In efficiency, the Lenape will rank among the finest vessels in the coastwise trade and also as regards appointments.

The construction of this ship is under the supervision of Theodore E. Ferris, naval architect and engineer, of New York, who also prepared the designs, plans and specifications in collaboration with H. H. Raymond, vice president and general manager of the Clyde line, C. D. Selden, for many years consulting engineer of the line, W. T. Webster, superintending engineer, Capt. C. D. Rockwell, marine superintendent, G. T. Edgcumbe, and D. D. Hargan, of the Clyde Steamship Co.

Collingwood Ship Building Co.

The Collingwood Shipbuilding Co., Ltd., at Collingwood, Can., is one of the busiest of lake shipyards. At present they have two large steel steamers for lake trade and one steel steamer for ocean trade, and two enormous steel dredgers, for the Canadian government of ocean-going type, fitted with elevator bucket dredging plant for digging in 52 ft. of water, for present service on the lower St. Lawrence ship channel. Besides this they have numerous smaller contracts on hand, as well as a large amount of job work and dry dock repairs, which is going on continually. They are at present employing about 800 men at the Collingwood yard.

They are associated with the Kingston Shipbuilding Co., Ltd., of Kingston, Can., where they built up about two years ago a modern steel shipbuilding and repair plant for carrying on new work as well as dry dock repairs. They are at present building two large lighthouse and buoy steamers for the Canadian government, and are employing about 300 men on the hulls and superstructure and general equipment of the ships. The engines, boilers and cabin interior finish are being built by the Collingwood Shipbuilding Co., at Collingwood.

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New Type of Centrifugal Pump

Description of the Roturbo Design Which the Manistee Iron Works Co. Will Manufacture

THE modern and successful development of rotary machinery of the form of electric motors and steam turbines has reacted on the centrifugal pump and created a demand for a design to meet all pumping problems and the highest efficiency, so avoiding gearing and reducing cost, weight and expense. Hitherto centrifugal pumps have fallen short of the general requirements of many problems due to their tendency to wear and consequently loss of efficiency when dealing with gritty water, also because of the lack of self-regulation or automatic adjustment to varying heads. Self-regulation when attempted, should be secured with the highest average efficiency over a wide range of duty.

Until about ten years ago it was generally agreed that centrifugal pumps were only suitable for low lifts and large volumes of water, such as occur in irrigation, sewage, salvage work and for circulating water for condensers.

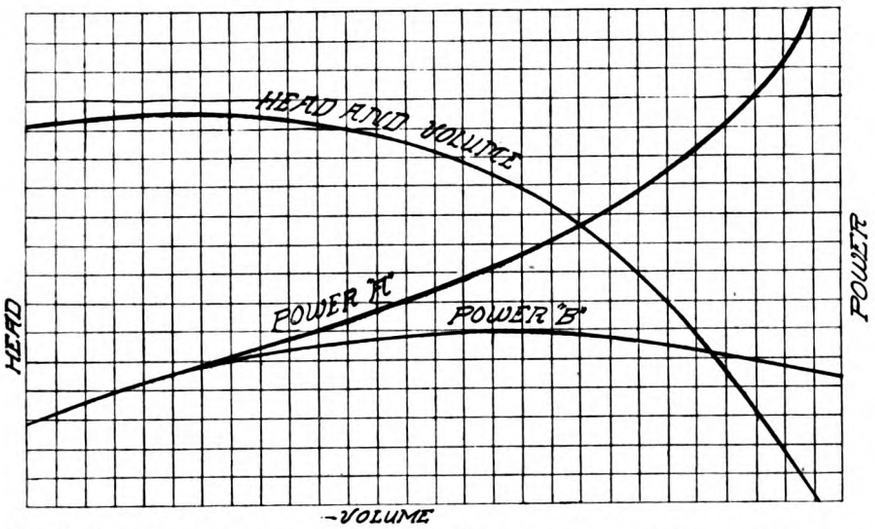

FIG. 1—COMPARISON OF POWER CURVES. A—ORDINARY TURBINE CENTRIFUGAL PUMP; B—REES ROTURBO CENTRIFUGAL PUMP

The efforts of early designers that the centrifugal type should not be limited to a few of the pumping problems of the world is shown by the patents taken out in the attempt to overcome the well known difficulties, and to make the centrifugal pump suitable for high lifts by using a number of impellers in series.

No doubt the delayed development was largely due to the fact that to get the best results from a centrifugal pump, impellers should be of small diameter running at high speed, rather than of large diameters running at low speed, but until the advent of the electric motor and steam turbine there was no means of driving centrifugal pumps at the necessary speed except through belting or gearing with their inseparable difficulties and losses in transmission, which neutralized the advantages aimed at in the pumps.

With the introduction of electric motors and steam turbines high efficiencies became possible and for high lifts the old arrangement of impellers in series was revised and the centrifugal pump became a strong competitor of the plunger pump for conditions which used to be looked upon as only suitable for reciprocating pumps.

Perhaps the defect which has been the most difficult to overcome and which has decided the buyer in many cases against this type of pump, has been the fact that it would only work at its best at the exact head for which it was designed, the reason of this being that the blades of the impeller were shaped so as to pass a certain amount of water with the minimum

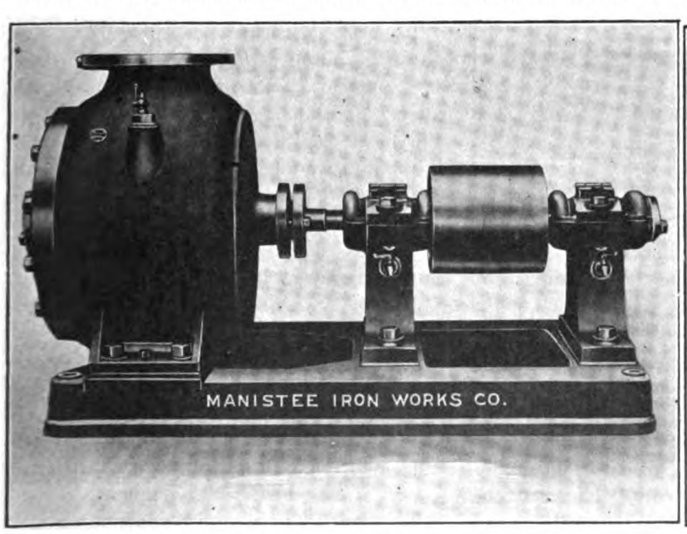

FIG. 2—STOCK OF ROTURBO PUMP

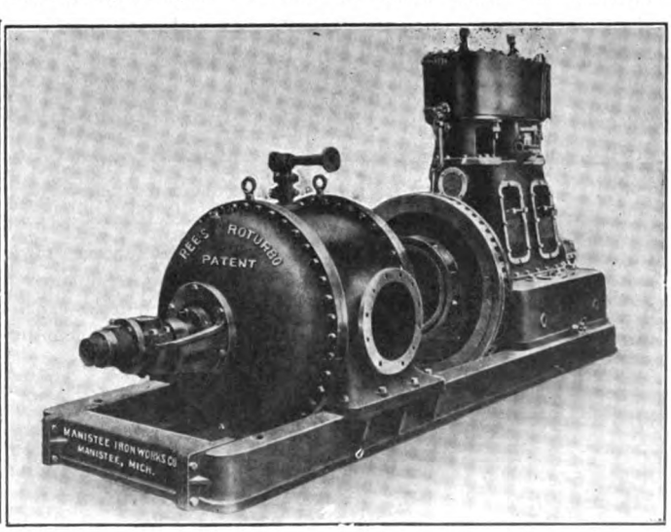

FIG. 3—STEAM-DRIVEN ROTURBO PUMP OF 400,000 GALLONS CAPACITY PER HOUR

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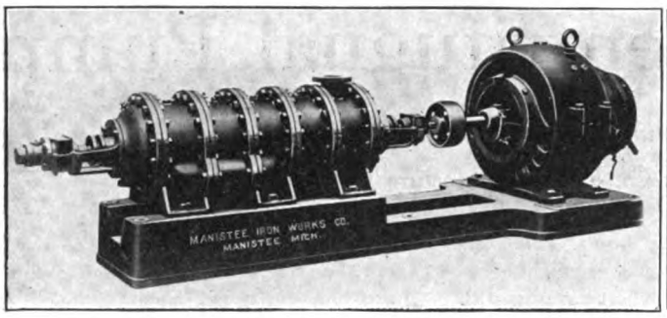

FIG. 4—LATEST TYPE OF REES ROTURBO BOILER FEED PUMP

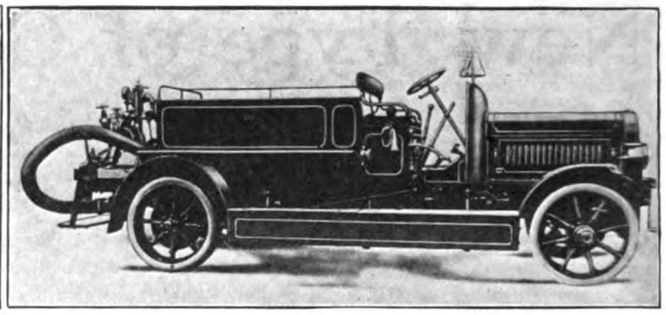

FIG. 8—APPLICATION OF ROTURBO PUMP TO FIRE ENGINE

friction of loss, due to cavitation; but if the head against which the centrifugal pump is working is reduced, a greatly increased volume of water passes and the impeller then becomes unsuitable for the increased speed of the water through it and begins to act as a water brake, thus creating an overload on the driving machine. Large numbers of motor-driven centrifugal pumps have given trouble or been burnt out by reason of this inherent defect if they have not had a large margin of power.

Since the variation of head either in the suction or delivery is one of the commonest conditions met with in pumping problems it has been a large handicap to the wider introduction of centrifugal pumps.

These conditions were well known and it was attempted to overcome them by designing the impeller with blades bent rearwards so as to reduce the brake effect. This necessitates increase in the speed of the impeller to compensate for the slip of the water and beyond a certain amount of re-curvature the capacity of the pump is very greatly reduced and the internal friction of the impeller increased with consequent loss of head at anything but a restricted range of service.

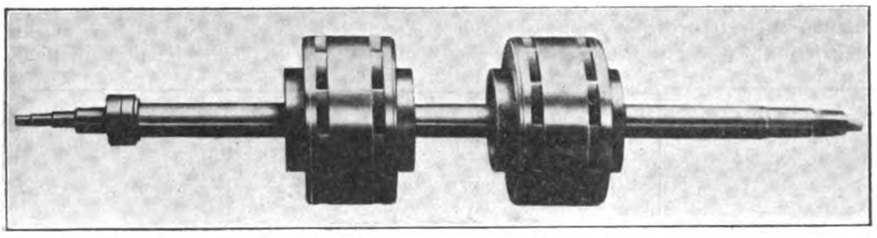

FIG. 5—PRESSURE CHAMBERS

The problem of varying heads has been completely solved by the invention known as the Rees pressure-chamber impeller which was placed on the market in Europe in 1907 by the Rees Roturbo Manufacturing Co., of Wolverhampton, England. The invention has been protected by patents in every country in the world by the parent company, the Rees Roturbo Development Syndicate, Ltd., Wolverhampton, England. Pumps are being sold under license in most of the European countries, among these may be mentioned Krupp, of Essen, Germany.

Since introducing this new type of pump many installations for all kinds of services have been installed abroad and in many instances where no other type of centrifugal pump could be used, these have given excellent service and satisfaction to the users.

The pump illustrated herewith constitutes an entirely new departure, the name "Roturbo" has been registered to denote the type.

The sole rights to manufacture and sell Roturbo pumps in this country and Canada has recently been obtained from the Rees Roturbo Development Syndicate, Ltd., by the Manistee Iron Works Co., of Manistee, Mich. This firm has been in business since 1871 as manufacturing engineers, and in 1907 they greatly extended their plant and improved their facilities so that their factory represents today one of the most modern and well equipped in the country capable of turning out a very large quantity of high class work for all classes of pumping machinery, including rotary air pumps and ejection condensers, etc.

The characteristic feature of this pump is, that it is a true turbine pump, that is to say, the "rotor" has a strong "turbine" effect, due to the water passing, hence the name—Roturbo. The turbine effect is secured by making the rotor of large capacity for storing water which is maintained by rotation at a constant maximum internal pressure with the minimum amount of loss, consequently, instead of throwing away the surplus speed energy of the water discharged when the head of delivery is reduced, the energy is extracted from the water before it leaves the pump casing.

Pumps of the Roturbo design present such marked characteristic differences in their operation and action compared with known types, as in effect to constitute them a new class.

In a pump constructed as described above, it is found that the power absorbed when running at a constant speed remains practically constant for all heads of discharge and heights of suction possible and never appreciably exceeds that required for the total head for which the pump is designed. Thus, such a pump is self-regulating, it being impossible by any variation of head suction to throw any excessive load or strain on the driving motor. There are no moving on parts in contact except at the bearings. The internal arrangements are such that the whole pump is in hydraulic balance and without end or lateral pressure on the shaft.

In the characteristic curve of the Roturbo pump it will be noticed that the power rises to a maximum at about normal head and volume, but the head can be reduced to any extent without affecting the power curve, and the discharge can be reduced below the atmospheric line, into vacuum, without any effect except reducing the power required for the motor.

If we now superpose a Roturbo characteristic curve on that of an ordinary volute centrifugal pump, when drawn to the same scale, Fig. 1, the vertical distance between the two power curves will represent the turbine effect extracted in this Roturbo from the water at any head and volume.

This curve marks the advance made and enables the Roturbo to be used under circumstances, which could right-

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ly have been considered impossible on a centrifugal pump before the advent of this new type.

In the Roturbo pump the design differs from the ordinary impeller or flat disc runner, which is formed with the main object of securing velocity of the water in the expanding channels of the fixed casing.

With the Roturbo pressure-chamber, the water, after being picked up at the eye, becomes practically stationary, relatively to the pressure-chamber itself, thus eliminating friction losses, and generating a pressure by centrifugal force.

The inner portion of the impeller between the eye and the largest section of the pressure-chamber may be looked upon as a centrifugal pump proper and the blades of this portion are designed similarly to those of an ordinary centrifugal pump. The rim portion, beyond the pressure-chamber, is designed as a reaction turbine, having rearwardly directed nozzles, discharging from the pressure chamber.

The pump is, therefore, always discharging with a constant pressure, which is the ideal condition for a centrifugal pump, and the turbine is always discharging from a constant pressure, which is the ideal conditon for a turbine. The result of a combination of a pump and turbine, with a pressure-chamber between them, is that the self-regulation is perfect, and at any heads lower than normal duty the power taken from the motor is prevented from rising. As the speed of the water in passing through the pressure-chamber is reduced, internal friction is reduced to a minimum and a high efficiency is secured without the necessity of machining or polishing blades or surfaces. The internal wear is also minimized.

In practice it is found with this type of pump that the highest efficiency point is at a duty in which the speed of the water issuing from the turbine blades is about half the periphery speed of the impeller. Consequently, the resulting speed in relation to the fixed casing is greatly reduced; as a result of this the diffusers may be removed some considerable distance from the periphery of the impeller, and there is nothing in the path of the water after leaving the impeller and the speed of the water being also low, it has been shown from all results that there is no tendency to wear at this point, even when pumping gritty water. This forms a marked contrast to the usual centrifugal pumps, whose facilities have to be provided for the renewal of blade tips and other parts, due to the excessive erosion. With much wear, of course the pump efficiency falls rapidly.

The illustrations show examples of these pumps for wide range of duties with their respective curves showing the actual power absorbed and the efficiency, and it is worthy of note that the efficiencies procured from Roturbo pumps are permanent efficiencies as the results depend much less upon diffusers effect in the casing than on the ordinary turbine pump, which is liable to considerable loss of efficiency when wear takes place. This is well illustrated in the efficiency procured from the Roturbo irrigation type of pump, which is especially designed for large volumes and medium and low heads such as are required in irrigation, sewage, and circulation pumps for condensers.

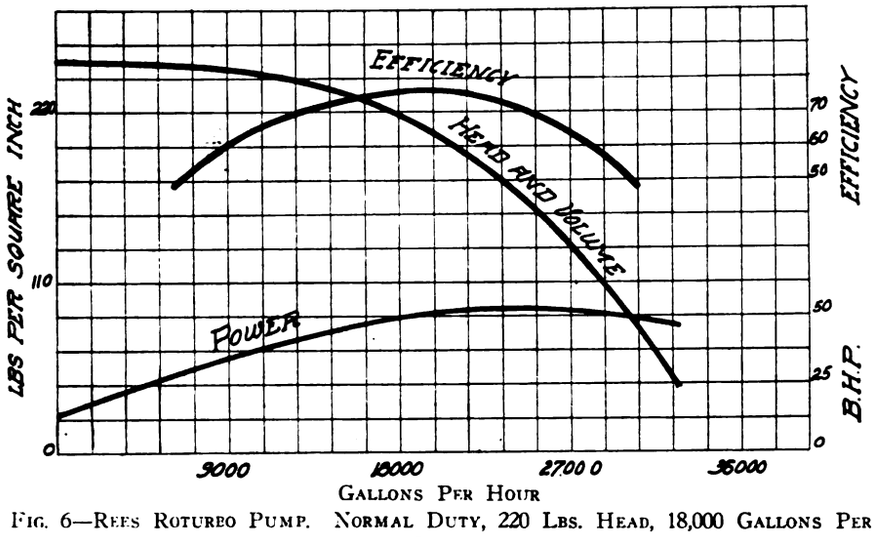

FIG. 6—REES ROTUREO PUMP. NORMAL DUTY, 220 LBS. HEAD, 18,000 GALLONS PER HOUR

In this type of Roturbo, Fig. 2, all the diffusers in the fixed casings are eliminated so that any suspended matter which passes through the pressure-chamber of the impeller has a clear flow through the fixed casing. The style which is a stock type meets all usual requirements for low heads, although embodying the simplest parts and construction, require no special care in machining, so forming a cheap type of pump. Owing to the low velocity of water through the pressure-chamber of the impeller, the efficiency is very much higher than the ordinary volute pump in this class, and this is secured without the use of diffusers. The efficiency is not only high but permanent.

Fig. 3 shows a steam-driven Roturbo pump, of 400,000 gallons capacity per hour that was installed in Nova Scotia, and was driven by a direct-connected steam engine of 300 B. H. P., running at 400 revolutions per minute. The pump delivered water against a head of 150 ft. The test at the works gave an efficiency of 84 per cent at the duty point.

Fig. 4 represents the latest type of the Rees Roturbo boiler feed pump, direct coupled to an enclosed ventilated, direct current motor. The pump impeller consists of a series of pressure-

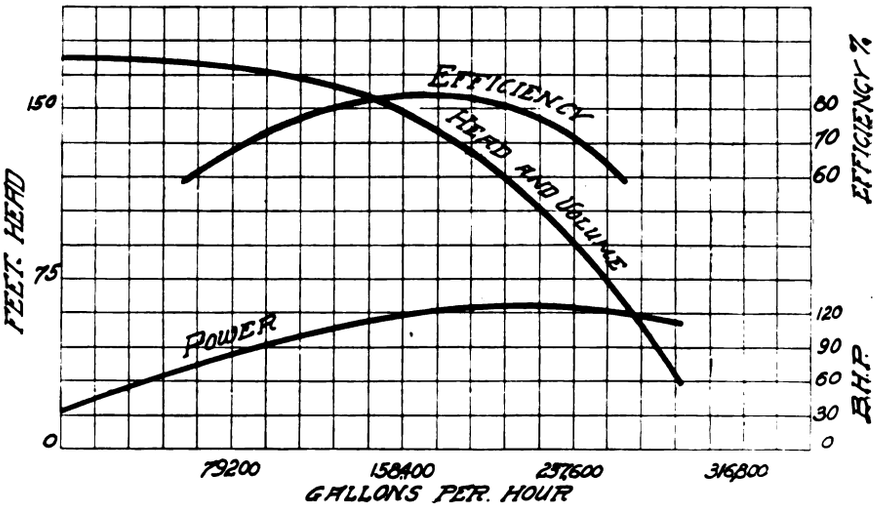

FIG. 7—REES ROTURBO PUMP. NORMAL DUTY, 150 FT. HEAD, 158,400 GALLONS PER HOUR

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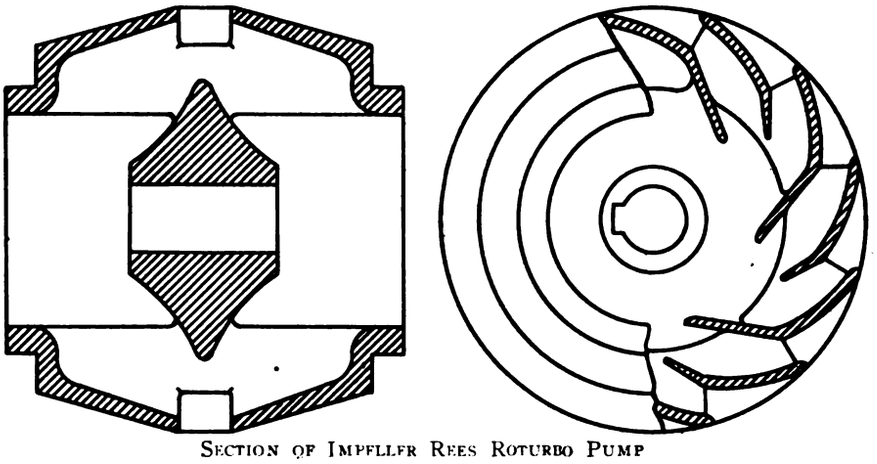
chambers which are mounted upon a central shaft supported upon bearings throughout the whole length except that portion passing through the chambers. The general appearance of these pressure-chambers is shown in Fig. 5. The whole pump is in perfect hydraulic balance. This feed pump on test, delivered 18,000 gallons per hour against a boiler pressure of 220 lbs. per sq. in., and took 50 B. H. P. to drive same, showing a pump efficiency of 76.5 per cent.



SECTION OF IMPELLER REES ROTURBO PUMP

Fig. 6 shows the characteristic curve and efficiency for the above.

An interesting example of a comparatively low speed Roturbo pump running at 925 revolutions per minute gave the high efficiency of 84 per cent. The duty of this pump is 150 ft. lift and a delivery of 158,400 gallons per hour at the above speed, the diameter of the discharge pipe being 12 in.

The curve shown in Fig. 7 gives the performance of the pump under test to meet stringent contract conditions. The overall efficiency of the pump and motor was shown to be 75 per cent.

When this pump was tested at the works the following results were procured: Starting from the duty point, viz., 158,400 gallons at 150 ft. head, the power is reduced from 120 H. P., to less than 40 H. P., as the discharge valve is closed. To the right of the curve when the discharge valve is opened so as to reduce the head against which the pump is working, the volume with minimum pressure is increased to double of that at the duty, showing that there is no throttling in the pump and no reduction of capacity.

The characteristic of the pump is shown in the power curve which, instead of rising at the lower heads, is actually reduced from 135 H. P. to 105 H. P., due to the turbine effect of the impeller.

Therefore, the Roturbo type of pump giving self regulation and high and permanent efficiency at constant speed coupled with the modern speed prime movers in shape of electric motors, steam turbines, gasoline engines, etc., finally removes the limitations of the centrifugal pumps entirely and the above illustration shows that there are few conditions of pumping that the Roturbo type of pump is not fitted for.

The Roturbo pumps are operated for pumping sewage, mines, coal mines, boiler feeds, pressure augmentors for city service, fire protection, dock pumping, cooling towers and condensing plants, etc.

They are also being used with exceptional advantage for fire-engine service. Fig. 8 shows an application of the Rees Roturbo pump for this service driven by a gasoline engine.

This machine is equipped with a 50-H. P. engine adapted to drive either the machine or the pump as required. The outfit attains a speed of 40 miles per hour when running on good roads. The efficiency obtained at the pump, viz., B. H. P. to W. H. P., was 74 per cent when working at the duty and against a pressure of 120 lbs. per sq. in.

Due to the self-regulating characteristics of this pump the streams can be delivered through any number of hose-pipes without overloading the engine when the head is reduced. Consequently, the maximum power of the engine can be utilized at all times, no matter what the head may be, since it runs at constant speed.

Operating Ships Without License

The steamboat inspection service has issued the following circular to owners, agents and licensed officers of vessels which is self explanatory. The circular is unequivocal in tone and apparently the service has become exasperated over the frequent repetition of a condition for which there rarely or never is any real excuse:

Section 4438, Revised Statutes, provides that—

It shall be unlawful to employ any person or for any person to serve as master, chief mate, engineer or pilot of any steamer or as master of any sail vessel of over 700 gross tons or of any other vessel of over 100 gross tons carrying passengers for hire who is not licensed by the inspectors; and anyone violating this section shall be liable to a penalty of $100 for each offense.

Violations of this character are becoming more frequent; and, in the appeals to the department for the mitigation or remission of penalties which have been imposed, the licensed officers offer as an excuse or explanation that they did not know that their licenses had expired, or that they had forgotten to have the license renewed, or that they were mistaken as to the date of expiration, etc.

Owners offer the excuse that they have no knowledge of the life of the license, or that as long as they are assured that the officer has a valid license when they engage him their responsibility ends, or that they can not be expected to know when a license expires, etc.

There is no reason why an officer should not renew his license upon its expiration and why owners should not be kept informed of the status of their officers, as every license issued states on its face the character of the license and that it is issued for a "term of five years" from a date given on the license, and the department takes this occasion to notify all persons interested that hereafter no leniency may be expected and no mitigation or remission of penalties respecting violations of section 4438, Revised Statutes, will be considered, except that it can be satisfactorily explained that such violations are not the result of indifference or neglect on the part of either owners or officers.

BENJ. S. CABLE,
Acting Secretary.

The United States engineer, Portland, Ore., is advertising for sealed proposals for the construction of two steel hull 24-in. dredges, Multnomah and Wahkiakum, which will be received at his office, 321 Custom house, until 11:00 a. m., Sept. 30, 1912. Information may be obtained by application to J. F. McIndoe, major of engineers.

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Isherwood System of Construction

The First of a Series of Articles Describing in Detail the Construction of a Small Steamer of This Type

By Robert Curr

Robert Curr begins in this issue a series of articles on a vessel, 203 ft. long, 40 ft. beam and 18 ft. deep of the Isherwood type, describing the method of computing the calculations necessary in designing the ship as well as showing how to order materials and how to build the vessel. Estimating the cost of labor and materials will also be shown in these articles. Every problem will be discussed, even to the shipbuilder's point of view on the unsinkable ship. Not a section will be overlooked and a reason will be given for the location of everything in the ship. This ship is of such convenient size that it will be comparatively easy for those interested in shipbuilding to grasp and master all the problems presented.

Specifications for Steel Steamship.

General Description.

To be a single deck bulk freight steamer.

Top gallant forecastle forward with deck laid flush, steel texas and pilot house on same.

Steel deck house aft containing dining rooms, galley and crew's quarters.

Accommodation for such part of crew as are not housed in after deck house to be in forecastle, boiler house or between decks aft.

Four cargo hatches spaced 24 ft. centers, with bulb angle coamings, wooden covers and patent hatch fasteners.

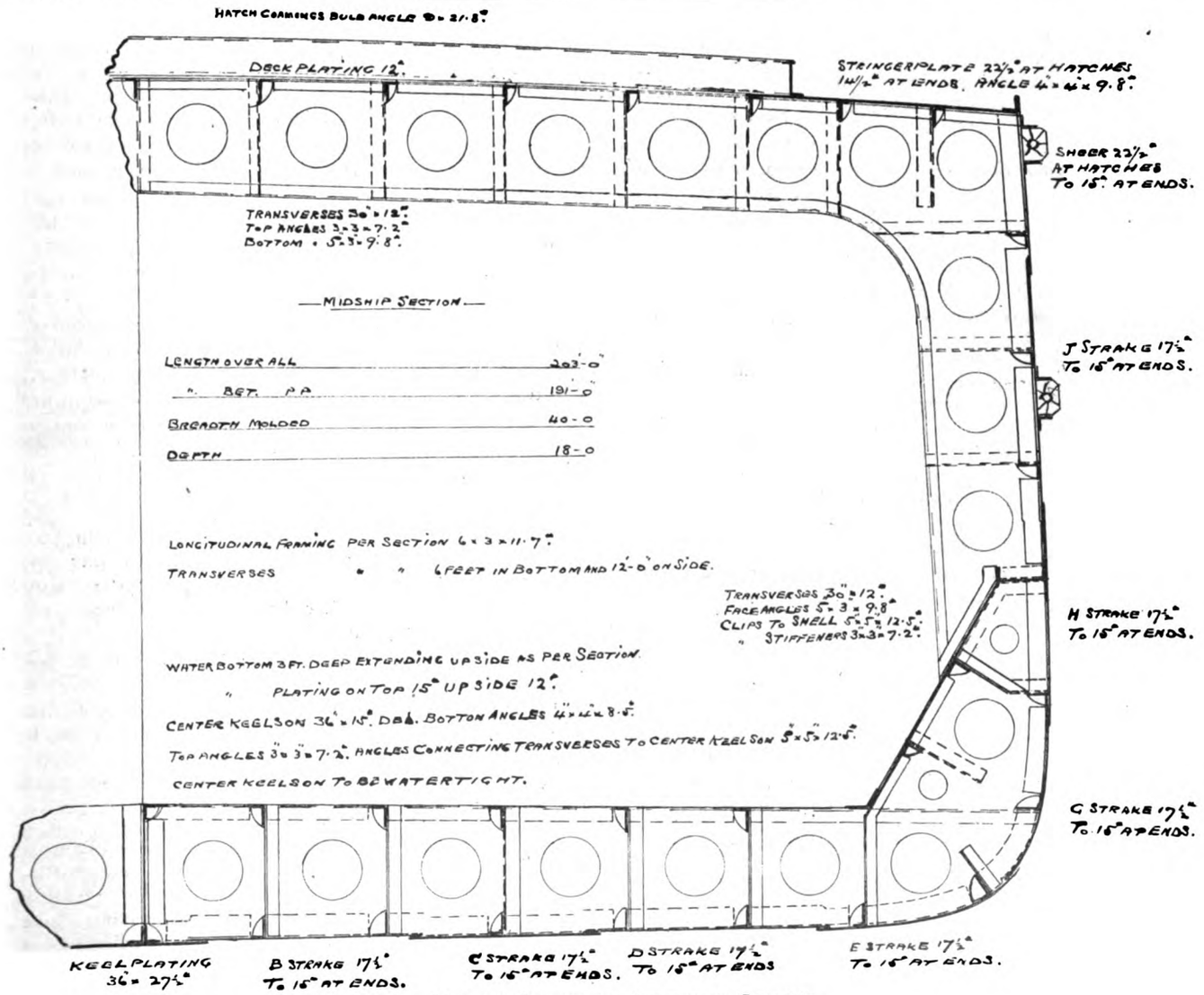
Water bottom to be 36 in. deep at center, with 3 in. of a camber and extending up the bilges for 5 ft.; tapering from 4 ft. at the tank top to 12 in. at the top on ship side. This side tank to extend from the coal bunker bulkhead to fore peak bulkhead. The water bottom to extend from forepeak bulkhead to stuffing box bulkhead and divided by center keelson and solid floors all water-tight.

Transverses to be spaced 6 ft. and webs 12 ft. throughout.

Triple-expansion engines placed aft and two Scotch boilers on tank top with fire room before them.

Coal bunkers at fore-end of stokehold, with 100 tons capacity.

To be built on the Isherwood system, with one intercostal longitudinal


HATCH COAMINGS BULB ANGLE 9 × 21.8#
DECK PLATING 12#
STRINGER PLATE 23½# AT HATCHES 1W½# AT ENDS. ANGLE 4 × 4 × 9.8#
SHEER 23½# AT HATCHES TO 15# AT ENDS.
TRANSVERSES 30# × 12#
TOP ANGLES 3 × 3 × 7.2#
BOTTOM " 5 × 3 × 9.8#
—MIDSHIP SECTION—
LENGTH OVER ALL 203'-0"
" BET. P.P. 191'-0"
BREADTH MOLDED 40'-0
DEPTH 18'-0
J STRAKE 17½# TO 15# AT ENDS.
LONGITUDINAL FRAMING PER SECTION 6 × 3 × 11.7#
TRANSVERSES " " 6 FEET IN BOTTOM AND 12'-0" ON SIDE.
TRANSVERSES 30# × 12#
FACE ANGLES 5 × 3 × 9.8#
CLIPS TO SHELL 5 × 3½ × 12.5#
" STIFFENERS 3 × 3 × 7.2#
H STRAKE 17½# TO 15# AT ENDS.
WATER BOTTOM 3 FT. DEEP EXTENDING UP SIDE AS PER SECTION
" PLATING ON TOP 15# UP SIDE 12#
CENTER KEELSON 36" × ⅝# DBL. BOTTOM ANGLES 4" × 4" × 8.5#
TOP ANGLES 3" × 3" × 7.2#. ANGLES CONNECTING TRANSVERSES TO CENTER KEELSON 5 × 3½ × 12.5#
CENTER KEELSON TO BE WATERTIGHT.
G STRAKE 17½# TO 15# AT ENDS.
KEEL PLATING 36" × 27½#
B STRAKE 17½# TO 15# AT ENDS.
C STRAKE 17½# TO 15# AT ENDS.
D STRAKE 17½# TO 15# AT ENDS
E STRAKE 17½# TO 15# AT ENDS.

MIDSHIP SECTION OF ISHERWOOD STEAMER

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at side continuous longitudinal framing and transverses scored out for same on bottom, side, tank top and spar deck. Spar deck to be steel and continuous.

Forecastle deck and main deck aft of steel. The scantlings throughout, material and workmanship, to be in accordance with these specifications and all including machinery and electric light plant to be first class.

Material

All plates and shapes to be mild open-hearth steel, tested at the mill to the following specifications: Tensile strength to be not less than 54,000, not more than 62,000 lb. per sq. in.; limit of phosphorus not to exceed 0.08; elongation to be not less than 24 per cent in 8 in. Reduction to be not less than 45 per cent. Reports of test to be furnished with invoices, and plates are not to run over or under theoretical weight more than 2½ per cent.

Rivets to be of the best open-hearth steel. Tensile strength to be not less than 52,000, nor more than 62,000 lb. per sq. in. Limit of phosphorus not to exceed 0.04, and limit of sulphur not to exceed 0.04. All material to stand work of shipment without injury.

Dimensions

Length over all	203 ft.
Length between P. P.	191 ft.
Width molded	40 ft.
Depth	18 ft.

Stem

To be the best hammered scrap iron, forged in one piece 8 in. wide and 2½ in. thick; the lower end to conform to the shape of fore-foot and to extend back far enough to form an efficient connection with the keel; the head to be carried above the forecastle deck rail to make a neat finish and to be reduced to 7 in. x 2 in. section beginning the taper above the load water line.

Stern Frame

To be of the best hammered scrap iron in one forging, with a suitable boss forged on for stern pipe, to be 8 in. wide and 5 in. thick below the boss and 4 in. thick above.

The upper end to conform to the shape of the counter and to extend high enough to be efficiently connected to the transom frame.

The lower end to extend with a fair taper forward not less than 7 ft. long, and well secured to the keel plates.

The shoe to be forged on the post, and to be 10 in. wide and 6 in. thick, the end to have forged hub to receive pintle of rudder. Brass bushing to be fitted for rudder-pintle.

Rudder

To be of the balanced type, made of the best hammered scrap iron, forged in one piece, with one cross stay. To be made to ship and unship while the vessel is afloat.

The frame to be covered on both sides with 12.5 lb. steel plates, the space between the plates to be filled in solid with wood.

The rudder to be hung on the transom floor, and to be fitted with proper bearings, and clamps. Stock to extend through spar deck with eye bolt in end for shipping.

Rudder to be operated by a quadrant below spar deck. Spare tiller of cast steel or wrought iron to be furnished.

Transverses.

From stem to fore-end of engine room, transverses composed of 12.5 lb. plate, intercostal clips 3 in. x 3 in. x 7.2 lb. angles. The plates to be depth of water bottom, and spaced 6 ft. apart.

In the hold the transverses will form webs 30 in. deep and spaced 12 ft. apart.

On the face of hold transverses, an angle will be fitted on same 5 in. by 3 in. by 9.8 lb.

The top of transverse riveted to the deck will be 30 in. wide and scored out for longitudinal frames to pass through. Transverses in bottom to be scored out top and bottom to allow the longitudinal frames to pass through.

On the side the transverses will be scored out for the longitudinals on the shell plating.

In the engine room the transverses will be spaced 36 in. apart in bottom.

Longitudinal Framing

Throughout, from stem to stern post, the frames will run lengthways from bulkhead to bulkhead, and bracketed to same with plate brackets and a sufficient number of rivets equal to the area of section of the continuous frame. The longitudinal frames to be of angle 6 in. by 3 in. by 11.7 lb. spaced 32 in. apart in the water bottom.

Longitudinals on side to be of angle 6 in. by 3 in. by 11.7 lb. 30-in. spacing above the water bottom.

Londitudinals on spar deck to be of 6 in. by 3 in. by 11.7 lb. spaced 33 in. apart.

Center Keelson

To be 36 in. deep, of 15-lb. plate, connected to keel plate with double angles 4 in. by 4 in. by 8.5 lb. and to tank top with single angle 3 in. by 3 in. by 7.2 lb. To extend as far fore and aft as may be practicable, and to be made water-tight in water bottom.

Tank Top

To extend from collision to stuffing box bulkhead, to be of 15-lb. plate. From the coal bunker bulkhead to the collision bulkhead the tank plating, 12½ lb. at side, will extend above tank at side of vessel 5 ft., the top of same being formed of channel 12 in. by 25 in.

Keel

To be 36 in. by 27 lb. plate in one thickness, all fore and aft. Keel bars to be joggled over butt straps.

Hull Plating

Between keel and sheer strakes, 17½ lb., reduced to 15½ lb. at ends.

Sheer strake K. 22 lb. in way of hatches, reduced to 15½ lb. at end.

Plating to be doubled around the hawser pipe. All strakes to be wrought in fair lines and have butts and seams lapped and made thoroughly water-tight.

An efficient arrangement of butts to be adopted. No liners to be fitted between transverses and shell plating.

Shell plating in way of water-tight bulkheads to be reinforced by suitable diamond shaped liners.

Spar Deck

Stringer to be in one width to hatches, 72 in. by 22 lb. in way of hatches. Inside of forecastle and abaft after house to be reduced to 15½ lb.

Plating, 12 lb.; longitudinals, 6 by 3 by 11.7 lb.; hatches, 27 ft. by 8 ft. by 24 ft. centers; coamings, 9 in. by 21.8 bulb angles; forecastle deck plating, 10.2 lb. laid flush.

Bulkheads

To be five in number. Collision bulkhead abaft the stem; one bulkhead in hold, coal bunker, boiler room, engine room and stuffing box bulkhead. Collision and stuffing box bulkhead, 12½ lb. Balance 10 lb. plating.

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Floating Dry Dock for Montreal

Description of the Structure Which Messrs. Vickers Have Built for Their New Canadian Establishment

MESSRS. Vickers, Ltd., last month started on her voyage to Canada, the floating ship dry dock built at their naval construction works at Barrow-in-Furness for their new establishment at Montreal. This dock is one of the largest yet built. It is capable of docking the largest existing vessel in the British navy. It is of the double-sided self-docking type, on the principle known as the "bolted sectional". It consists of a pontoon or lifting portion of the dock, and two parallel side walls, built on to and forming part of the same, and the whole length is divided into three complete and separate sections, which, when bolted together, form the complete dock. These sections are so arranged that when the dock is separated into its three parts, any two of them can dock the remaining third between them. For this purpose each section is fitted with its own independent pumping machinery, so that it can also act as an independent unit.

The general dimensions of the dock are as follows:

	Ft.	In.
Length over platforms	600	0
Length over pontoons	550	6
Width over all	135	0
Depth of pontoon at center	17	0
Length of side walls	470	6
Height of side walls above pontoon deck	42	0
Width of side wall at base	17	6
Width of side wall at top	12	6
Clear width between roller fenders	100	0
Draught of vessel	27	6
Lifting capacity, tons	25,000	

The construction of the dock is such as to make it suitable for lifting a modern British battleship, the pontoon deck being specially stiffened to allow it to support a large portion of the weight of the vessel on side or bilge, as well as central, keels.

Divided Into Three Sections

The pontoon consists of a rectangular structure plated in all round with the exception of the portion of the deck which comes directly under the walls, and stiffened internally by longitudinal and transverse girders. It is divided into three sections by joint chambers. The two end sections have their outer extremities built in the form of a point or bow terminating in a working platform carried on plate and braced girders. The bottom plating, except under the walls, is arranged to run transversely, and is connected to the plating of the sides and points by chine angles; the top or deck plating, similarly arranged, is connected to the face of the side wall by chine angles. The pontoon is divided into four compartments by three longitudinal intercostal water-tight plate-bulkheads. Transversely the pontoon is divided into 54 bays, 20 in the central section and 17 in each end section, by transverse girders, consisting of plate-bulkheads. In the compartments under the walls the plate-girders are replaced by special lattice-girders.

In addition to the bulkheads, the deck and bottom platings are stiffened by means of a series of longitudinal frames which run fore and aft over the length of the pontoon, intercostal between the transverse girders. In addition to the transverse lattice-girder under the wall, intermediate transverse ordinary frames are fitted 2 ft. 6 in. apart, and are prolonged upwards, forming the ordinary frames of the walls. The central bulkhead between the transverse girders is stiffened by vertical "breathing" plates, which are well stiffened and connected to a longitudinal curtain-plate. Outside this framing of breathing plates and longitudinal curtain-plate, the pontoon deck and bottom are stiffened by longitudinal framings consisting of angles, connected to the transverse bulkhead stiffeners by gussets and diagonals. These framings extend to the line of the face of the wall. In the center section several of these frames are provided with plates riveted to them, to take the load from the side keel-blocks. The intermediate longitudinal bulkheads are formed of vertical plates, intercostal between the transverse girders, to which they are attached, as they are also to the top and bottom plating. To facilitate the complete withdrawal of all water in the pontoon, shallow troughs are fitted, which form a gutter.

Horizontal Plating

The walls of the dock are plated horizontally and have a batter on the face or inside wall. The top deck of the walls is plated longitudinally, and is connected to the side plating by double-chine angles. An engine-deck, on which is placed all the machinery of the dock, is fitted about 16 ft. below the top deck, and is arranged water tight. Each wall is divided, in addition to the joint chambers, into ten water-tight divisions by plate bulkheads, coming in line with the bulkheads in the pontoon, of which they are a continuation. At each end of the wall a docking land is formed, on which the central portion can rest when being self-docked. The framing of the walls is of two types, braced and ordinary.

In line with the transverse girders of the pontoons, of which they form a continuation, the frames consist of single angles stiffened by vertical web-plates, the front and back frames being cross-connected by a series of diagonals and gussets. The ordinary frames of the walls consist of single angles back and front, cross-connected by a series of horizontal struts. Special stiffening is fitted in way of the machinery. About 1 ft. below the top deck a running deck is provided for enabling ropes to be easily handled and run from one end of the dock to the other outside the stanchions. Timber-heads and such fittings required in berthing vessels are fitted on this deck. At a distance of about 15 ft. and 29 ft. respectively below the running deck, two further stages, known respectively as painting and shoring stages, are provided.

Can Work in Independent Units

Each end of the central section and each square end of the terminal sections is provided with a joint chamber, by means of which the sections can be joined together or parted. For the purpose of dealing with commercial vessels, which ordinarily will not have the weight or dimensions of the Dreadnoughts, the dock has been designed so that it can work when required in two independent units of unequal size, and to facilitate the rapid connection of the two portions, cast steel rocking joints, in the form of knuckles, are fitted at the level of the keel blocks. The pumping installation of the dock is driven by steam generated in boilers carried on the dock itself. Each section of the dock has its own complete pumping installation, and each installation consists of two boilers and two engines and pumps installed

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in specially constructed chambers on one of the walls.

The pumps, which are of the centrifugal type, 17 in. in diameter, are seated on a main drain at the bottom of the dock, which is continued over practically the whole length of each section. From the main-drain compartment pipes are led to each separate water-tight division of the dock. Each compartment is governed by its own separate valve, and the main inlet pipe and pump discharge pipe are governed by separate screw-down valves, and in addition have each a non-return flap-valve on the outside. The compartment valves of each section of the dock are all operated from a valve-house placed on the top deck of each section, by means of the Westinghouse electro-pneumatic system, which is based on the principle of operating presses by compressed air and controlling the same from a distance by means of valves operated by an electro-magnet. Each valve house is in telephonic communication with its respective engine room and also with the others when the dock is working as a single unit.

Pumping Equipment

Each section of the dock is also provided with a direct-acting steam-pump, arranged to draw from the sea, and capable of providing a full stream of water for fire service or washing down vessels. These pumps are also connected to the main drain, so that they may be used as a drainage service for completely emptying the compartments. Two similar steam pumps are also fitted on the opposite wall of the dock.

Steam heating is provided to prevent water in the compartments from freezing, and also for the mechanism that could be affected by frost. Each water tight compartment is provided with the Gardner & Ferguson indicating system, to show, in the valve house, the level of the water inside it. Similar gear is also provided for indicating the draught of water over the keel blocks. The dock is provided with eight steam capstans, four on each wall. The spindles of the capstans are carried down vertically to the level of the pontoon deck, where, in a small chamber in the wall at this level, cable lifters are fitted, so that the mooring cables may be hauled in or paid out when the dock is being moved about. Donkey boilers are provided on the wall remote from that in which the main boilers are fitted, to provide steam for the capstans and fire pumps fitted on that wall. On the top deck of this wall a 3-ton electric traveling gantry crane is fitted and arranged to traverse the whole length of the wall. At both ends of the combined dock a pair of flying gangways or swinging bridges are fitted, affording access from one wall to the other.

Lighted by Electricity

The dock will be lighted throughout the machinery compartments by means of electric lamps. The outside lighting consists of bracket standards, each supporting a cluster of lamps. Box terminals are also fitted on the walls, from which lamp clusters can be taken by flexible leads for lighting any particular portion of the ship on the dock. Electric current will be supplied through cables from the shore.

The dock is provided with the usual bollards and timber heads. Roller fenders are also fitted to protect the walls of the dock from an entering steamer. Eight mechanical side shores, four on each wall, are provided. These can be screwed in or out by a standard fitted on the top deck. Keel blocks, side or docking keel blocks, and bilge blocks are provided; the latter are arranged to be pulled in or out to suit the shape of the ship when she has taken the keel-blocks. The keel blocks are strongly made and closely spaced, to enable them to take the weight of the heaviest and most modern ironclads. Ladders are fitted leading from the upper deck of the dock to the pontoon deck, and also into the various compartments of the dock. Suitable hand rails are fitted all round the top deck.

Ventilation by means of cowls and downcast pipes is arranged to each boiler and engine room, and also to the interior of the walls. A valve house large enough to contain the valve control table and the recording instruments is fitted on the top deck of each of the three sections; each valve house contains the apparatus necessary for controlling the valves of its own particular section.

Electric Impulse Transmitter

The Gardner-Ferguson electrical impulse transmitter is an instrument which has been devised with a view to obtaining regular and incremental electrical impulses from any motion in any position, and transmitting these impulses to any distance and there reproducing them synchronously, thus forming a history of a motion no matter what it is. In essence the apparatus consists of a spindle which is rotated, or oscillated, by the motion of which a record or observation at a distance is required. On this spindle are diametrically mounted one or more straight glass tubes which have a platinum wire fused into each of their closed ends, the tubes being partially filled with a special mixture, of which mercury is the principal component. On the requisite movement of the spindle the tube, or tubes, alternately pass through the horizontal plane, thereby causing the mercurial mixture to flow in the tube and make a momentary electrical connection between the end platinum wires and allowing an electrical impulse to flow. Collecting-rings are fixed on the spindle, and by means of these the impuse current is conducted through the external circuit to any distance which may be required. A simple mechanical device is attached to the spindle which prevents the tubes from stopping in the horizontal plane and thus causing a short-circuit.

The instrument as described above is in its most simple form, and is suitable for a motion in one direction only, as, for example, from the index or counter of any form of meter, or for the transmission of time from a master-clock to any number of synchronizing dials. If, on the other hand, the motion is reciprocating, regular or irregular, sometimes in one direction and sometimes in another, a simple commutator is fitted, which is operated by the same spindle which carries the glass tubes. An instrument with four glass tubes, and fitted with such a commutator for reciprocating motion, is illustrated in Figs. 1 to 3. The arrangement of the commutator will be clearly understood from these figures. It is in essence a change-over switch, the moving part of which is carried by an arm which rides on the spindle, and the fixed part of which consists of two contacts carried by brackets from the bottom of the case, as shown. The moving arm is spring-controlled, so that as the spindle begins to move in the direction different from its previous motion, the arm springs across and makes contact with the opposite pair of contacts from that it was previously in connection with. The two contacts are connected up so that each sends the impulses in the transmission circuit in an opposite direction from the other. It is usual to make the transmission circuit with a single wire and an earth return, but a three-wire arrangement can be used if desired. It is obvious that the glass tubes form the only part of this apparatus which can be looked upon as of a special and more or less untried nature, but exhaustive tests have been made of its reliability. Tubes have been selected at random, and individu-

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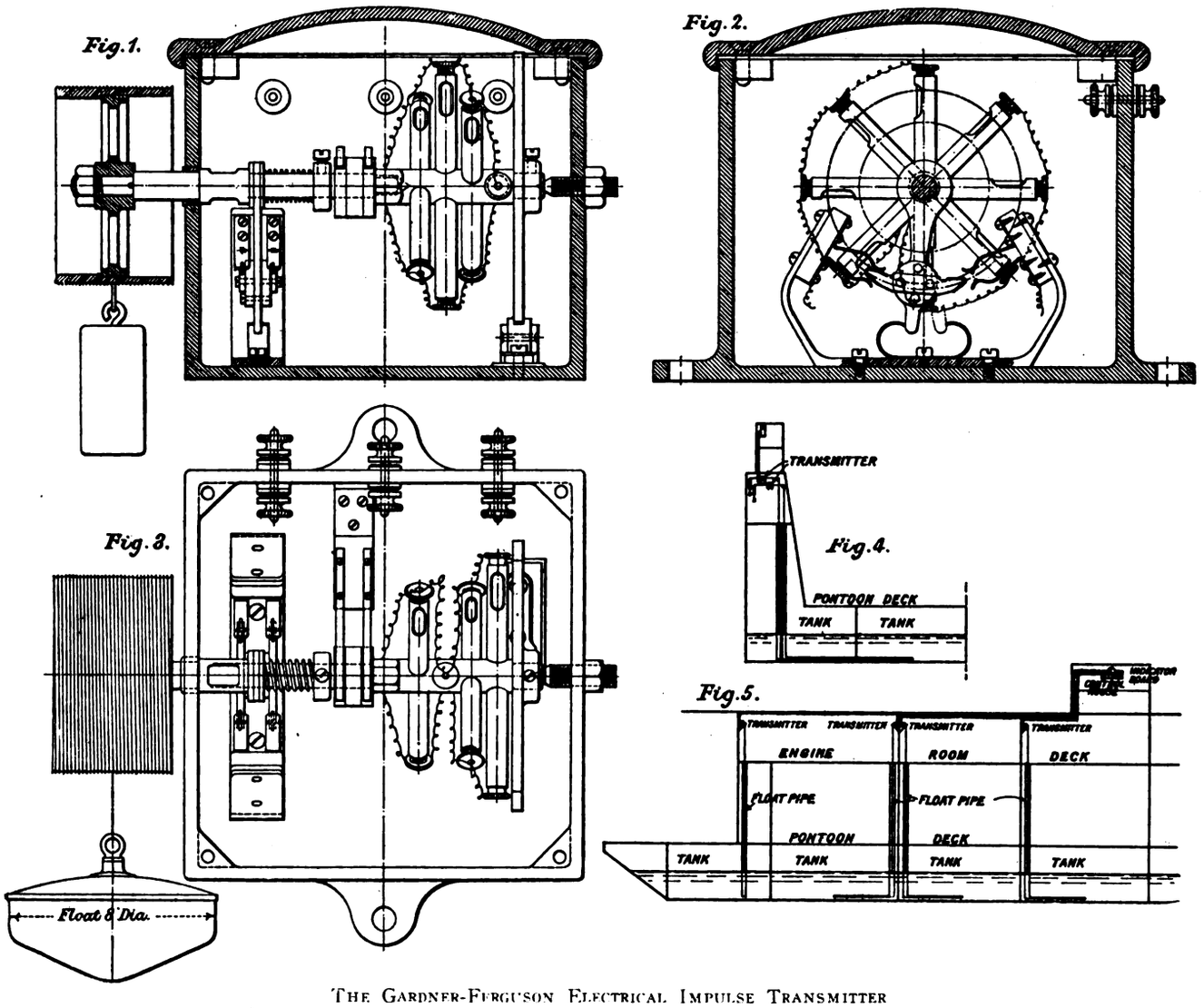

THE GARDNER-FERGUSON ELECTRICAL IMPULSE TRANSMITTER

ally subjected to 5,000 electrical flashes at a pressure of 220 volts, coming through the ordeal absolutely unimpaired, the usual electrical pressure employed in working rarely exceeding 12 volts, so that the tests indicate an endless life to the tube under normal conditions.

The receiver employed to manifest the impulses is of a very simple nature. For short distance transmission the impulse current energizes an electro-magnet, thereby pulling down an armature, this armature, acting through a lever rotating a toothed wheel one tooth at a time, either from left to right, or vice versa, as the case may be. An important point in connection with this arrangement is that the toothed wheel is locked on the succeeding tooth as soon as the armature starts from rest, and before the wheel even moves. It is simply a matter of suitable gearing thereafter to obtain the desired indications. For long-distance work, where the impulse is too much attenuated to operate magnets, the impulse is caused to temporarily bias the balance of a polarized relay; this connects in a local battery which simply does the work of operating the magnets, so causing the receiver to move one way or the other synchronously with the original motion. The receivers are designed to work either with or without a recording arrangement, as may be desired, such records not in any way affecting the precision of the instrument. The records will be found to be an exact history of the motion as regards time.

It may be used, for instance, for time-keeping, a master clock operating a number of dials, or it may be used for the transmission of meter readings, and the reading of counters of all kinds. It may also be used to indicate liquid levels, as, for instance, reservoir or water-tank levels, oil-tank or chemical tank levels, river water levels, tide levels, etc. It is also suitable for the transmission of pressure indications. This apparatus was utilized for indicating on the launching platform of the Japanese battle-cruiser Kongo at the Vickers Works, Barrow-in-Furness, the depth of water on the end of the launchways, and the speed of the rise of the tide in the channel into which the vessel was launched. As a reliable transmitter of depths of liquid levels the Gardner-Ferguson invention supplies a long-felt want, which owners of floating docks, wet docks, oil-storage tanks, oil-carrying steamers, etc., have not been slow in appreciating, and a large number of instruments for these purposes are now being supplied. An application of the apparatus to a floating dock for indicating the depth of water in the tanks is illustrated in Figs. 4 and 5. It has been fitted on the new floating dock for Montreal. The manufacturing rights of the transmitter have been acquired by Chadburn's Ship Telegraph Co., Liverpool.

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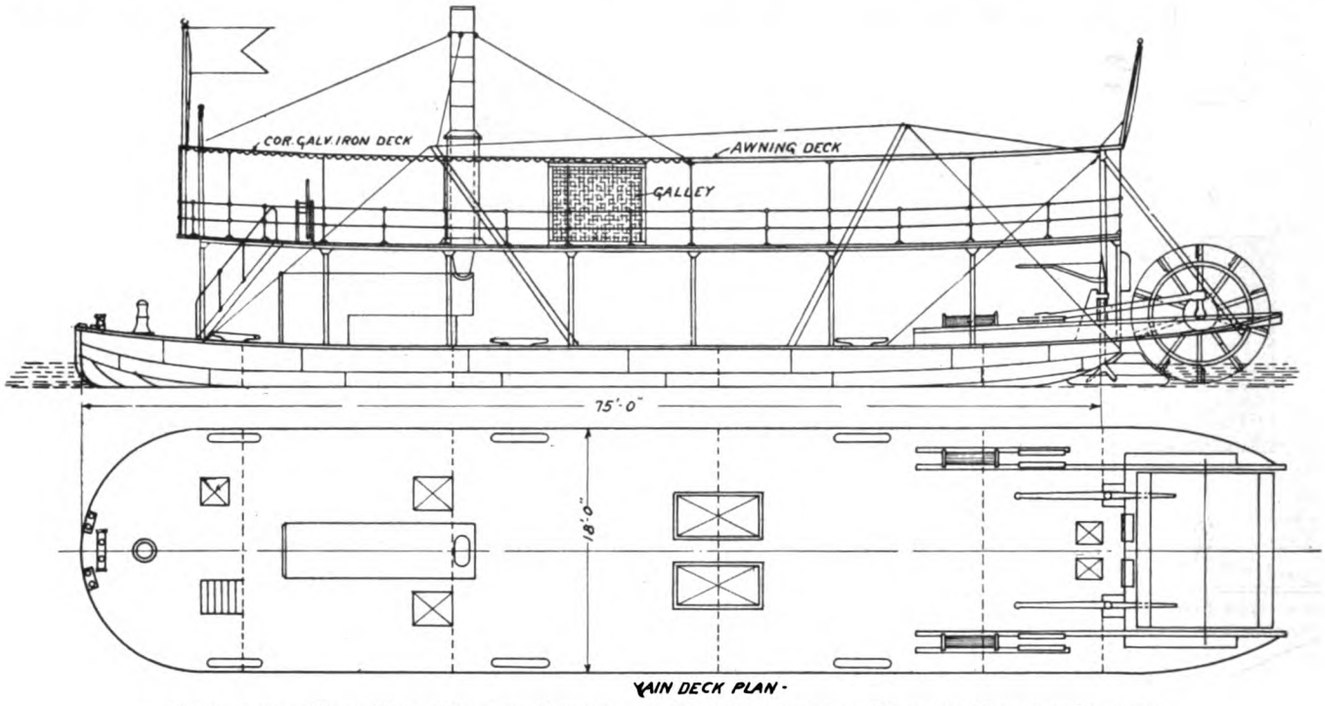
Towboats for South America

James Rees & Sons Co., Pittsburgh, Pa., has built up quite an extended business in the construction of towboats and barges for service in Central and South American waters. The vessels are shipped by the company in a knocked-down condition to the point of destination and there assembled. At present the company is building three stern-wheel towboats and six flat rake barges for the Madeira-Mamore Railway Co. The towboats are of the stern-wheel type, 75 ft. long, 18 ft. beam and 3 ft. deep, with an 18-in. sheer forward. The hull is constructed of open-hearth and angle steel throughout, the plating being galvanized and double riveted. There are four cross bulkheads and one center fore and aft bulkhead. The barges are 75 ft. long, 18 ft. beam and 3 ft. depth of hold with 12-in. sheer and having a corrugated steel cargo box. They are constructed of open-hearth and angle steel throughout, double riveted and plating all galvanized.



PROFILE AND MAIN DECK PLAN OF STERNWHEEL TOWBOATS FOR THE MADEIRA-MAMORE RAILWAY BUILDING BY JAMES REES & SONS CO., PITTSBURGH

Question of Smaller Battleships

Naval authorities in Britain just now, as well as shipbuilders, are busy arguing the pros and cons of smaller battleships and it seems possible that Great Britain will lead the way back again to battleships of medium tonnage, just as she did to Dreadnoughts. Perhaps this movement may have its effect on the passenger line companies, and at any rate should it have any result, it will be hailed with satisfaction by a large majority of shipbuilders and would also have its effect on the demand for labor.

Sir William H. White, late chief constructor to the British admiralty, is head of a growing school of thought which contests the wisdom of Sir John Fisher and his colleagues and their Dreadnought policy.

Sir William White's views are that a wiser course in warship building would be found in a return to more moderate dimensions and a reduced unit cost for capital ships than have recently found favor. Experience had established the fact that, without having resort to extreme dimensions, it was possible to produce capital ships which would be powerfully armed, well protected, steady gun platforms, capable of fighting their guns in all weathers when actions could take place, and able to maintain their speed in rough weather.

Admiral Sir Reginald Constance points out that in the Russo-Japanese and Spanish-American wars the defeated ships were generally beaten before their floating power was compromised and the armored hulls of the victors did not exercise any decisive influence on the results. As the ship need not be made absolutely unsinkable, but only sufficiently so to win victory, should not the difficulty of hitting the water line, he asks, be carefully considered before diverting large weights from guns,—the most effective form of defense—to armor which gives imperfect protection?

Launch of Steamship Pastores

Workman, Clark & Co., Belfast, launched from their South yard a new twin screw steamer, built by them for the United Fruit Co., and to engage in the general fruit carrying and passenger service between New York and West Indian ports. The Pastores is 486 ft. in length, with a gross tonnage of about 8,000 tons, and has been built in accordance with the requirements of the British Corporation Registry of Shipping, the British Board of Trade and the United States Steamship Inspection Service.

A special feature of the vessel is the accommodation for about 150 first class passengers in which comfort and artistic taste are admirably combined. The staterooms, arranged for one, two and three persons, are all roomy apartments, a number of them being so arranged with doors and adjoining lavatories as to be available for family suites, while there are also seven special cabins luxuriously furnished and provided with separate lavatories.

The public rooms include commodious dining saloon, with tables arranged on the restaurant plan, a luxurious music room opening off the main entrance hall; also a comfortable smokeroom. All the rooms, public and private, are efficiently ventilated by means of cooled fresh air delivered through ducts, while each

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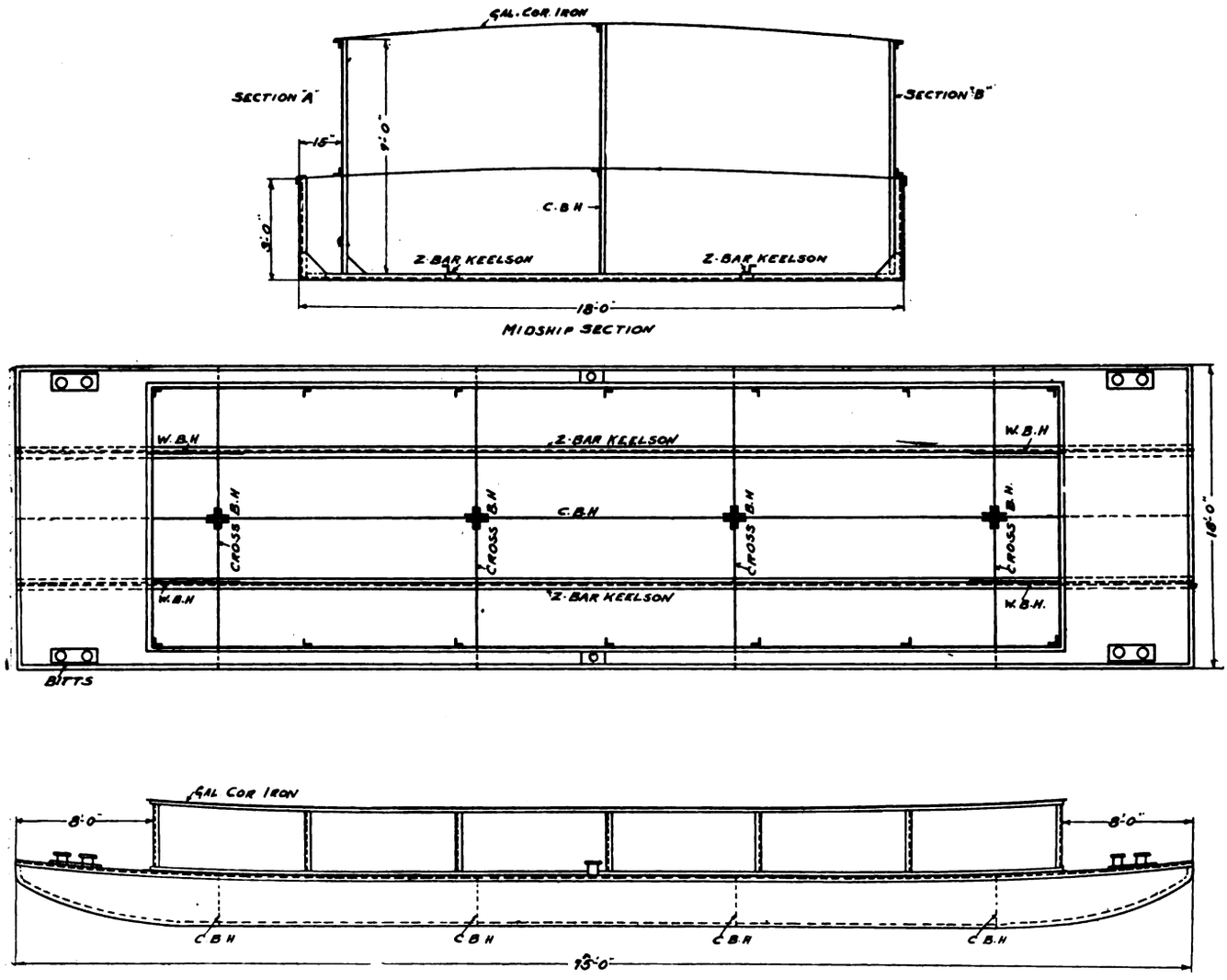

SECTIONAL VIEW OF STEEL TOW BARGES FOR THE MADEIRA-MAMORE RAILWAY CO.

room is also provided with electrically-driven fans.

The cargo space of the vessel is divided into nine compartments, all specially insulated and prepared for the carriage of fruit in bulk. This perishable cargo will be preserved during transit by means of cooled fresh air delivered by electrically-driven fans through ducts from the refrigerating rooms to each compartment.

The propelling machinery consists of two independent sets of quadruple-expansion engines of approved design, complete with all necessary auxiliary machinery and supplied with steam from three double-ended and one single-ended steel cylindrical multitubular boilers.

The Samuel L. Moore & Sons Corporation, Elizabeth, N. J., are developing a type of freight-carrying power boat for shoal water service and have recently turned out one 64 ft. long, 16 ft. beam and 6 ft. deep.

A Remarkable Tow

The tug Reliance (formerly the M. E. Scully) owned by the Isthmian Canal commission, has recently completed a remarkable trip with three barges in tow. She left Cristobal Feb. 11 for Panama bay via the Straits of Magellan, reaching her destination on June 17 after a voyage of 126 days and 10,500 miles. The number of actual steaming days was 86. Heavy seas were occasionally encountered which kept their decks awash. The Reliance is fitted with a No. 3 Providence steam towing machine of the Shaw & Spiegle pattern, having double cylinders 14 in. in diameter and 14 in. stroke, using 1,200 ft. of 1¼ in. steel wire hawser. Instances have been noted from time to time of steamers taking a single barge in tow from New York to San Francisco and from New York to Liverpool, but this is believed to be the first time that a tug has ever attempted a triple tow for such a distance. The trip certainly demonstrates the advantage to be derived from using a towing machine, which relieves the sudden shocks and strains upon the hawser.

W. R. Grace & Co.'s Plans

W. R. Grace & Co. have made extensive plans for the development of the coast-to-coast trade upon the opening of the Panama canal. Four steamers for this service are now building at Philadelphia, which will be of 10,000 tons each, 405 ft. long and 54 ft. beam. Upon their completion, about July, 1913, a fortnightly sailing service will be inaugurated between New York and San Francisco from each port. With the addition of the three steamers now building in England and destined for the New York and West Coast South American trade, via the Straits of Magellan, the fleet of Grace & Co. will number 16 steamers. The steamers under the British flag will be operated by the New York & Pacific Steamship Co., which is controlled by Grace & Co.

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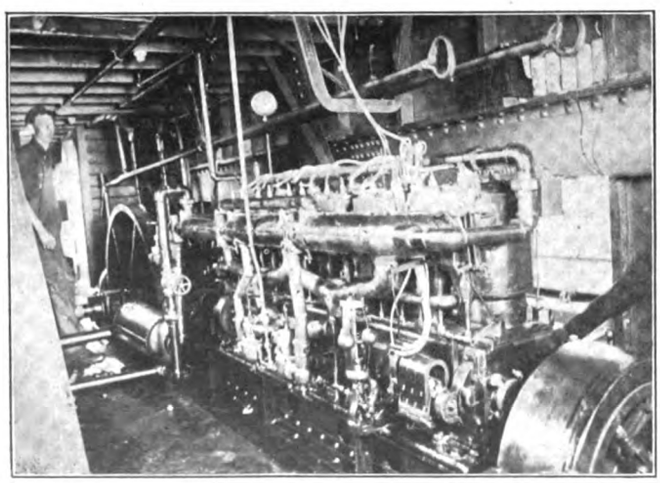
BROADSIDE VIEW OF GASOLINE CAR FERRY HENDERSON

Gasoline Car Ferry

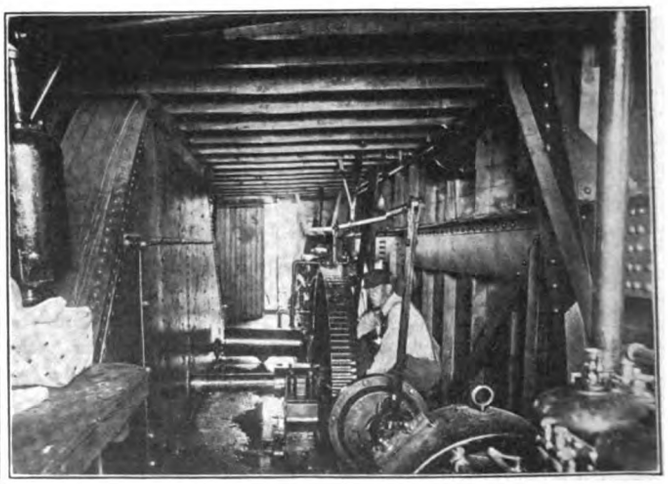
Showing the Adaptability of This Form of Power to a Wide Variety of Uses

The Evansville Railway Co., Evansville, Ind., has recently established a car ferry service across the river at Henderson, Ky., which marks a somewhat interesting departure for craft of this character. The car ferry is designed to transport the interurban cars across the river, making it unnecessary for the passengers to change cars. The interesting point about the ferry is that it is propelled by two 54-H. P. Buffalo gasoline engines, 7 in. bore and 9 in. stroke, with a normal speed of 350 R. P. M. Each engine drives one side paddle wheel but additional gearing is provided so that one engine may operate both wheels if necessary. Power is transmitted to the wheel shafts through large bevel gears at a ratio of 10 to 1. The paddle wheels are 10 ft. in diameter, 3 ft. wide and have 20 blades 18 in. deep. The conditions of service are such that the car ferry is required to make only one round trip every hour, whereas it can cross the river in 6 minutes with the current and 8 minutes against. Obviously she has much idle time while waiting for the interurban cars to arrive. With a steam plant this would mean a waste of fuel, as steam would have to be kept up all the while. With the gasoline engine when the ferry stops the consumption of gasoline stops. Economy therefore dictated the use of this form of power.

The ferry was designed by Morris H. Whitaker of Nyack-on-Hudson, and is constructed entirely of steel, being 130 ft. over all, 34½ ft. beam on deck, 25½ ft. beam on water line. Her displacement in light condition is 88 tons, and in loaded condition with two interurban cars 150 tons. The general design of the car ferry is well shown in the accompanying illustrations. The track is placed in the center of the boat, and the cars run aboard under their own power. The pilot house is carried on stanch-



ENGINE ROOM, CAR FERRY HENDERSON, LOOKING AFT, SHOWING STARBOARD MOTOR



PORT VIEW OF ENGINE ROOM OF CAR FERRY HENDERSON, LOOKING FORWARD, SHOWING CLUTCHES, GEARING, ETC.

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ions amidships well above the wires and is flanked on both sides by little deck houses which protect the port and starboard engines. The crew consists of four men, including the pilot.

The gasoline tanks are placed on top of the houses over the engines. It was the desire of the railway company to have a boat of as light draught as possible and of low freeboard, so as to get the weights as low as possible. This necessitated a very shallow hull and in order to get requisite fore and aft strength, the designer worked out a pair of bridge girders, the bottom member of which was on the bottom of the hull and the upper members above the deck, the hull plating being secondary to these bridge girders and to supplement them. In fact the boat practically amounts to a pair of bridge girders plated up so as to give sufficient displacement to carry the load and be seaworthy for river service. Four watertight bulkheads were used dividing the hull into five compartments so that the boat would be floatable with any one of the middle compartments or both end compartments open to the sea.

The entire construction except the houses covering the engines and the pilot house is built of steel varying in weight from 7½ to 12½ lbs. The track is carried on two heavy yellow pine stringers bolted through the deck and supported transversely under each of the vertical struts of the bridge girder by channel beams so that the weight of the cars is transmitted directly to the bridge girder instead of to the hull proper.

The usual river type of bridge at the ends was used and the ends of the hull designed to conform with this river type of bridge.

Bilge pumps are provided on each of the main motors and also air pumps for the whistle. An independent centrifugal pump, 3 in., is connected to the flywheel at one of the main motors through clutch and silent chain drive. This pump is designed for fire and bilge purposes and so connected that water can be drawn from each of the watertight compartments of the hull and discharged overboard or can be drawn from overboard and discharged through the fire hose. Each pump has a capacity to supply 150 gals. per minute under the pressure of 200 lbs.

The boat is equipped with double rudders and steering wheels after the usual ferry boat type and a searchlight is also provided on top of the pilot house for use when making landings. The boat is fully equipped to meet government requirements for a boat of this size and purpose.

The car ferry was built by the Dubuque Iron Works, Dubuque, Ia., and a trial run was made of the journey from Dubuque to Evansville. The car ferry made an average of 8 miles an hour, and during the last 48 hours of the journey the engines were not stopped for a single second.

DECK VIEW OF CAR FERRY HENDERSON, LOOKING AFT

The White Star Line has decided to make extensive alterations in the Olympic as a result of Lord Mersey's recommendations. As soon as she is withdrawn from regular service this fall she will be sent to Belfast and subdivided longitudinally. Her present bulkheads are wholly transverse and the effect of the alterations, coupled with a water-tight deck carried well above the water line, will virtually make a double ship of her.

The Boston Iron & Metal Co., of Baltimore, which purchased the troopship Yosemite from the navy department last spring, have decided to break her up.

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United States Collier Jupiter

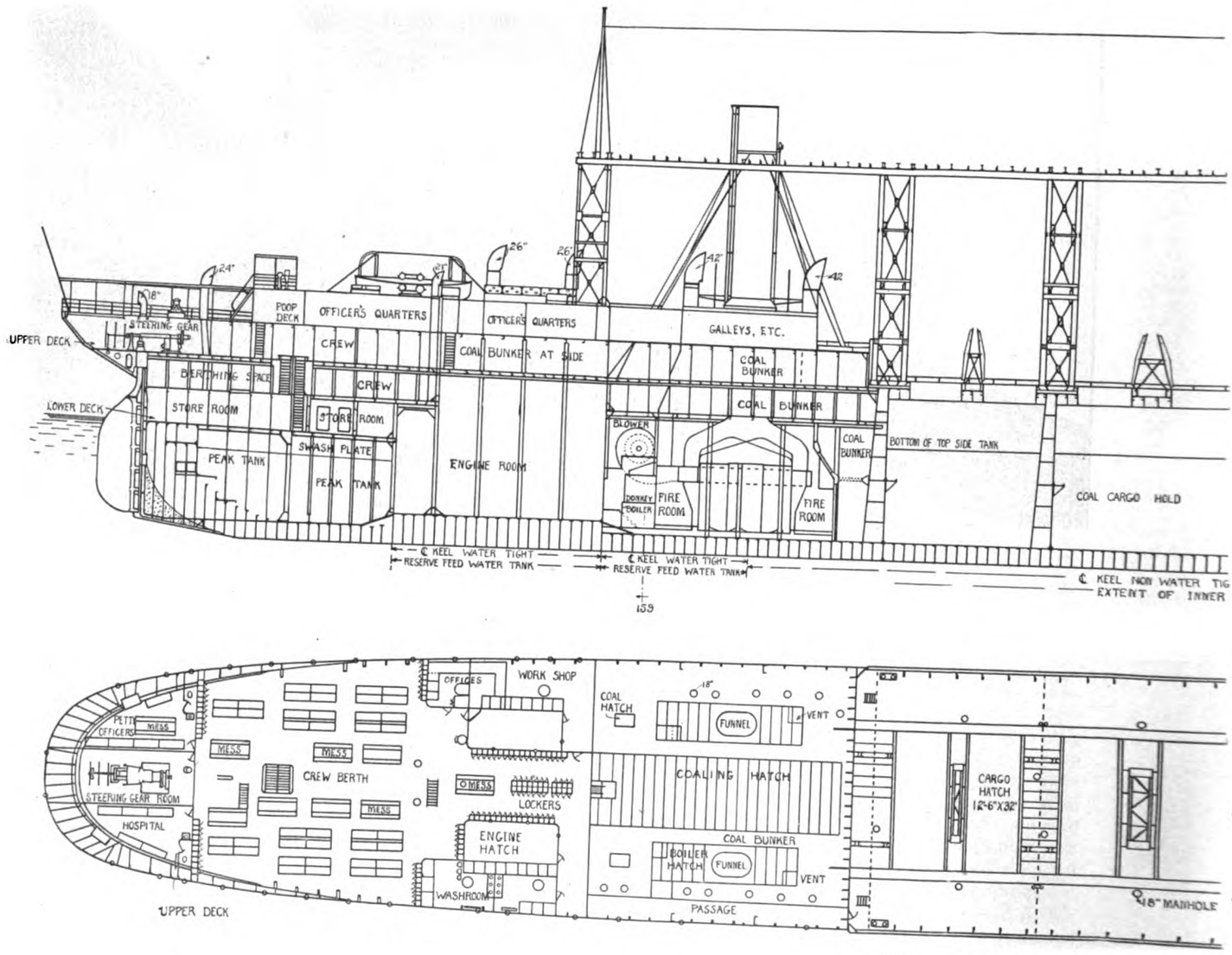
Launch of the First Electrically-Driven Collier at the Mare Island Navy Yard — Description of Hull

The United States collier Jupiter, building for the navy department at the Mare Island navy yard, was launched on Saturday, Aug. 24. She is the first electrically-driven sea-going vessel to be built for the navy department and the description of her electric drive was published in the August number of the REVIEW. The Jupiter is of the following general dimensions:

Length of hull, 542 ft.
Length between perpendiculars, 520 ft.
Breadth, 65 ft.
Depth of hold, 36 ft. 9 in.
Mean draught, 27 ft. 8 in.
Displacement, 19,132 tons.
Bunker capacity, 2,043 tons.
Cargo capacity for coal, 10,500 tons.
Designed speed, 14 knots.

The construction of the collier was authorized in the naval act passed May 13, 1908. The cost was limited to $900,000. Estimates showed that the collier could not be built for less than $1,200,000, which sum was authorized to be expended by congress on March 4, 1911.

The keel of the Jupiter was laid on Oct. 16 last, and the work of construction has proceeded rapidly since. She is a practical duplicate of the Cyclops as far as hull equipment goes. The Jupiter is of the single-deck type with forecastle, bridge and poop with double-bottom ballast tanks extending from after end of oil stowage proper to after end of engine room and upper wing ballast tanks, formed in a triangular space between the deck and side outboard of the cargo hatches. Her trimming tanks are installed in both forward and after peaks. The water ballast arrangements are such that the vessel may be maintained with not more than 1 ft. trim by head when full cargo on board and bunkers empty and not more than 2 ft. by stern with full bunkers and full cargo coal. Suitable space is provided outside of the regular cargo holds for the carrying of about 1,000 tons fuel oil in bulk. In addition, one cargo hold is so riveted and caulked and fitted with bulkhead and coffer-



INBOARD PROFILE AND UPPER

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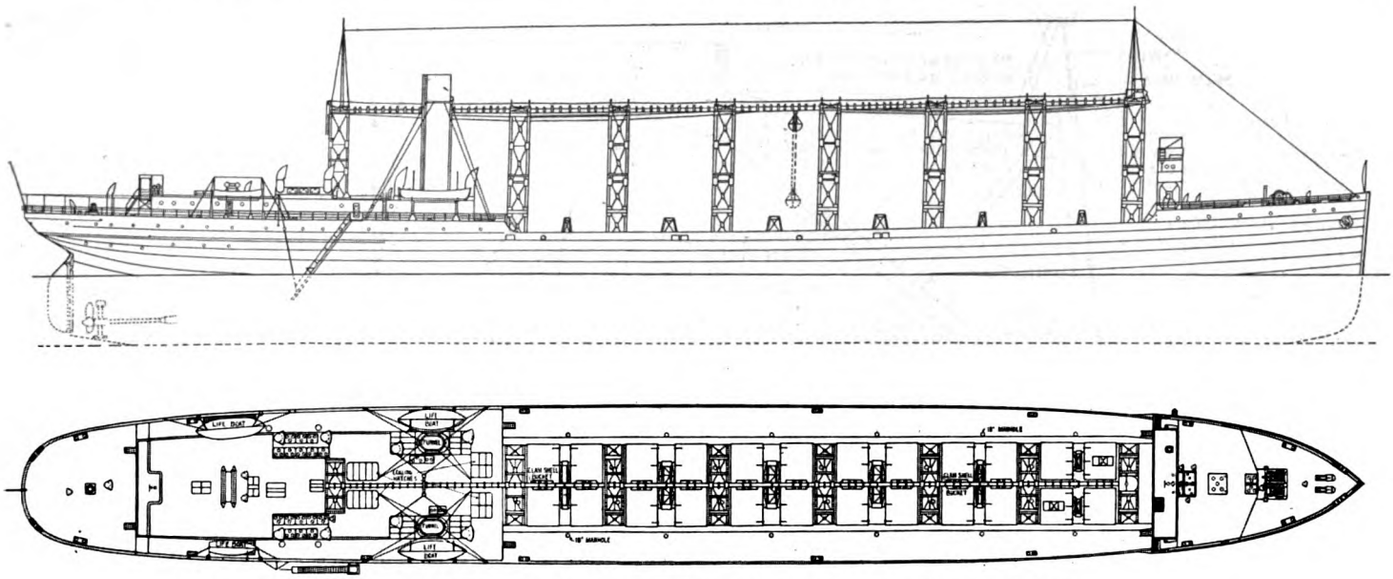
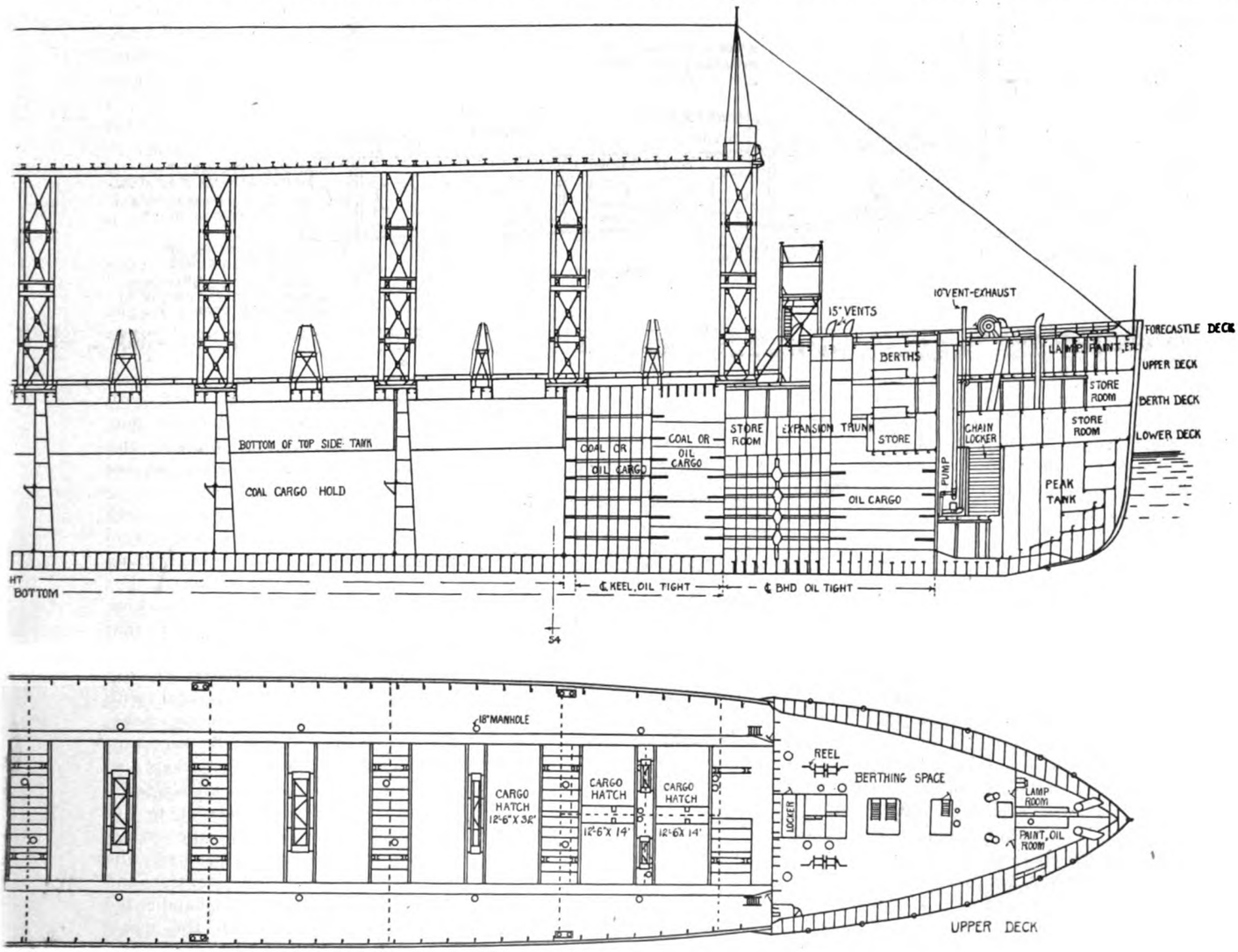


OUTBOARD PROFILE AND UPPER DECK PLAN OF COLLIER JUPITER

dam that it may carry either coal or oil.

The Jupiter has, of course, been designed with a view of subsequent installation of arrangements for coaling at sea and all possible interferences provided against. Coaling space has been provided on deck at both bow and stern to facilitate handling coal in bags.

The Jupiter is to have a continuous sea speed of 14 knots loaded with



DECK PLAN OF COLLIER JUPITER

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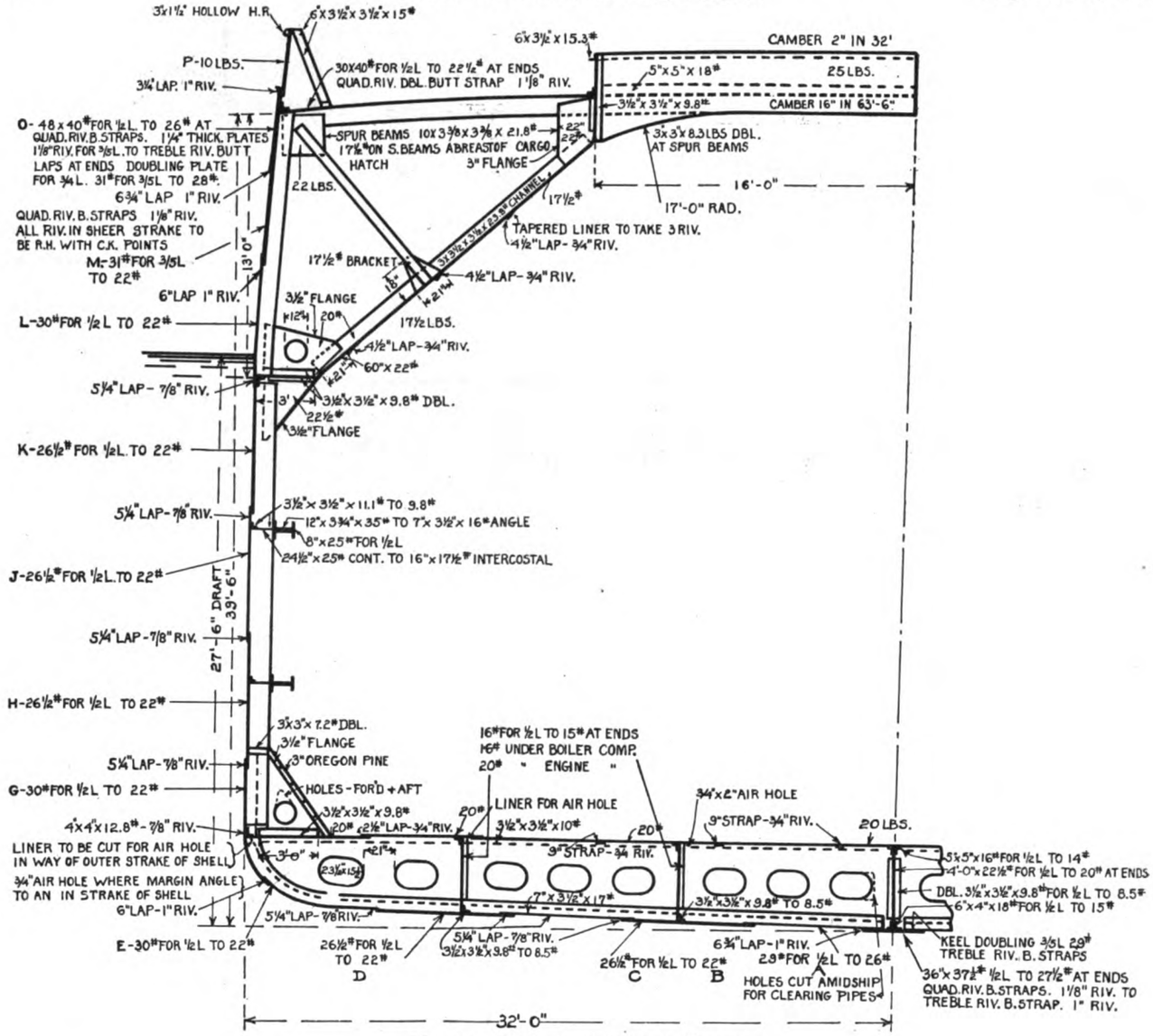
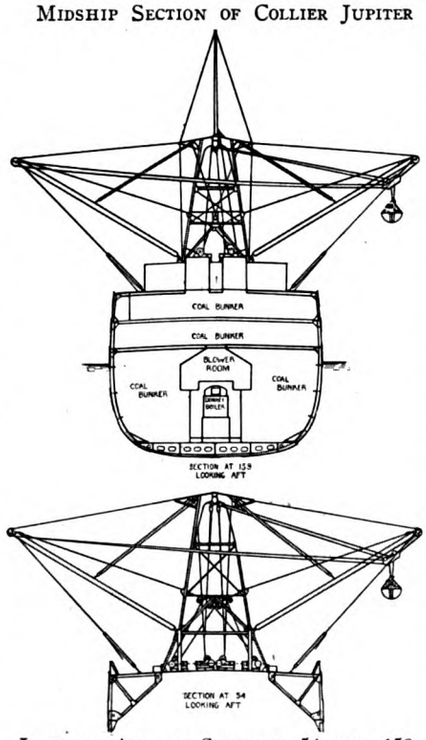


MIDSHIP SECTION OF COLLIER JUPITER

12,500 cargo and bunker coal, of which the bunker coal is to be about 2,000 tons, conveniently located for loading and trimming to fire room, 100 tons of reserve feed water, 20 tons drinking water and 130 tons for stores and crew. With the above load the mean draught molded must not exceed 27 ft. 6 in. and a free board molded to be not less than 12 ft. The beam must be sufficient to give satisfactory stability with full cargo of coal without the use of water ballast. The metacentric height shall not be less than 24 in. in full loaded condition.

The Jupiter has six cargo holds, one of which, as stated, is subdivided and fitted for oil carrying. Each hold is fitted with two hatches so constructed that coal shall be self-trimming. Provision has been made to transport coal forward and aft to prevent excessive variations of trim when bunker coal is used and arrangement by which on long trips the cargo coal may be supplemented



LOOKING AFT AT SECTIONS 54 AND 159

by bunker coal. She is fitted with masts for signaling and lookout purposes suitably located forward and aft, and suitable for coaling at sea when towing or being towed.

The Jupiter is to be provided with complete appliances for the rapid and efficient coaling of vessels along side or to storage on a wharf. For this purpose special masts or king posts are to be so arranged that cargo can be unloaded either with clamshell buckets of at least one-ton capacity, or for handling coal with large skips or standard navy bags; to be provided with all necessary winches and clamshell buckets so that each cargo hatch can be worked to coal a vessel alongside or to put coal over one side of the vessel simultaneously from all hatches. The winches to have metallic friction and to be of ample power to handle the loaded clamshell buckets, the masts or king posts and booms to be provided with all necessary standing and running rigging and gear, coaling

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skips of one cubic yard capacity to be provided for each hold in addition to the clamshell buckets.

The Jupiter is to be arranged with quarters and accommodations of the character usual in a high grade cargo steamer for a crew consisting of the following: One commander, one executive navigating officer, one senior engineer, three watch officers, one medical officer, one pay officer, one boatswain, one carpenter, three warrant machinists, one pay clerk and 150 enlisted men.

The Jupiter is provided with complete system of piping for pumping the ballast in connection with the engineer's pumps, with piping for filling and discharging oil, with sanitary flushing system, baths and hand drainage pumps. A suitable system of fire protection is also to be installed in the hold.

Remarkable Case of Grounding

One of the most remarkable cases of grounding recorded in Pacific maritime annals in years was the experience of the steamship City of Seattle, owned by the Pacific Coast Steamship Co., which, after being high and dry for 15 hours, was found entirely undamaged. The steamer was able to proceed on her next voyage without docking, which seems remarkable when it is considered that she hung on a rocky bottom and was entirely out of water for hours.

The City of Seattle is a freight and passenger steamship plying regularly between Seattle and Skagway, Alaska, via ports. She is an iron steamer, of 767 tons, built at Philadelphia in 1890. On the morning of Aug. 15, while returning from Skagway with 120 passengers aboard, many of them excursionists, she went ashore at Charcoal Point, 2 miles south of Ketchikan, near the British Columbia border. The mishap was due to a dense fog. Capt. Johnson had meanwhile stopped his engines. Suddenly the vessel took the ground with scarcely a jar and when the passengers come out to breakfast four hours later they found themselves surrounded by dry land. The receding tide had left the vessel entirely out of water. So easily had the City of Seattle taken the ground that a majority of the passengers were not aware of the accident. During the day the tourists enjoyed the novel experience of walking about the Seattle and examining her hull. With the flood tide they went aboard and 15 hours after the steamer went aground she was floated on the high tide with the assistance of the steamship Northland. The accompany photograph shows the City of Seattle resting on a rocky shore waiting for the flood tide.

REMARKABLE PREDICAMENT OF A STEAMER

Many Oil Tankers Building

Of the fifty to sixty oil-tankers now building in British shipyards—chiefly on the northeast coast—at least twenty-five are for the Pearson syndicate, otherwise the Eagle Transportation Co., which is allied to the Mexican Eagle Co. This syndicate owns a large oil installation at the Manchester docks consisting of five tanks with a capacity of 12,700 tons, equivalent to 3,448,232 gallons. Many of the remaining number are for big oil corporations of the Anglo-American and British petroleum companies, who control the premier installations at the Manchester docks, viz.: Anglo-American Oil Co., 19 tanks of 20,687 tons (5,617,000 gallons) capacity, and British Petroleum Co., thirteen tanks of 46,259 tons (12,560,520 gallons) capacity. The others are chiefly for shipowners who have been identified with the oil-carrying trade for some time, and have at least in the last two years found it an extremely profitable business. This extraordinary activity in the building of oil-tankers points to wide dispersal of oil in the near future—its distribution, in short, from the oil field to the consuming centers, and particularly to oil depots at the world's leading ports, where the fuel can be stocked ready for calling steamers.

The Eastern Steamship Corporation, of which Calvin Austin is president, has taken possession of the Dominion Atlantic Railway steamship line between Boston and Yarmouth, and will build two steamers for the service.

Some Suggestions to the Board of Trade

The British Board of Trade caused to be printed during the Titanic disacter a list of suggestions made by various correspondents on the subject of saving life at sea, and there were certainly some suggestions made. For instance one correspondent suggests that icebergs be destroyed by "radium shots." Sounds good, but expensive. Another correspondent, evidently of an ecclesiastical turn of mind, thought that all vessels hereafter should be launched in the presence of a bishop. A third suggested that the funnels be used as lifeboats—very helpful indeed, and it is curious that no architect ever thought of it before. A fourth suggested that the rudder be fitted in the engine room—and why not? It couldn't get injured by ice there. Another suggested "a device for stopping vessels by reversal of engines," which is good, but not original. Another gentleman thought that steamers should be fitted with buffers and icebergs with electric bells. Altogether 424 suggestions were submitted and some of them, of course, were good ones, as for instance that a better lookout should be kept in zones of known danger. An efficient lookout would have averted the Titanic's accident, though it is now clear that some of the wireless warnings of the proximity of icebergs never reached the bridge at all.

Capt. Ruser, executive officer of the Kaiserin Auguste Victoria, is to bring out the new Hamburg-American steamship Imperator, and has been detached from sea service in order that he may daily inspect the construction of the Imperator and be familiar with the great ship in all its details.

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September, 1912

Panama Canal Bill

Practically the last thing that congress did before it adjourned was to pass the Panama canal bill. The salient features of the bill are that it permits American vessels engaged exclusively in coastwise service to pass through the canal free of tolls; that it admits to American register foreign-built ships when owned exclusively by Americans and confined exclusively to the foreign trade, and that it forbids vessels owned in whole or in part by the railroads to pass through the canal. In addition, ship building materials necessary for the construction or repair of American vessels built in the United States are to be admitted free, but there is nothing new in this particular provision, for it has virtually been in effect during the past 15 years and very little advantage has ever been taken of it.

As soon as congress passed the bill, Great Britain protested against it for the second time on the ground that it violated the Hay-Pauncefote treaty. President Taft in signing the bill sent a memorandum to congress explaining his attitude. In discussing the British protest against the exclusion of American shipping from the payment of tolls for the use of the canal the president said that the irresistible conclusion to be drawn from the protest is that although the United States owns, controls and has paid for the canal, it is restricted by treaty from aiding its own commerce in a way that all commercial nations of the world may freely do.

The president pointed out that the rules specified in the article of the treaty which are made the basis for the British protest were adopted by the United States as a basis of the neutralizing of the canal and for no other purpose. The article he maintains is a declaration of policy by the United States that the canal shall be neutral; that the attitude of this government towards the commerce of the world is that all nations will be treated alike and that no discrimination would be made by the United States against any one of them observing the rules adopted by the United States. He maintains that it was not intended to limit or hamper the United States in the exercise of its sovereign power to deal with its own commerce, using its own canal in whatsoever manner it saw fit. The president argues that if there is nothing in the Hay-Pauncefote treaty preventing Great Britain and other nations from extending favors to their shipping using the canal and if there is nothing that gives the United States any supervision over or right to complain of such action, then the British protest leads to the absurd conclusion that this government in constructing the canal, maintaining the canal, and defending the canal, finds itself shorn of its right to deal with its own commerce in its own way, while other nations using the canal in competition with American commerce enjoy that right and power unimpaired.

It is absolutely beyond our power of reasoning to discover what possible basis there can be for the British protest against allowing American ships engaged in coastwise service to pass through the canal free. There are no other ships than American ships engaged in this service. It is a purely domestic problem with which no nation has any concern whatever. However, Great Britain is very much wrought up over the subject if its periodicals, which are publishing reams of matter on the subject, are to be believed. To our way of thinking, the only sensible thing we have read on the subject in a British paper is the following from *The Nation*:

"America as a protectionist country has stringent navigation laws. No foreign ship is allowed to engage in coastwise traffic between American ports and moreover her courts have given the widest interpretation to the term 'coastwise traffic'. All this had obvious bearing on the Hay-Pauncefote treaty. Its provisions for equality of treatment could not apply to vessels engaged in coastwise service and using the canal, because only American vessels in fact were so engaged. *If the treaty meant that American ships which enjoy the monopoly under the navigation laws when plying around Cape Horn between the eastern and western coasts of America should lose that monopoly when they used the canal, it should certainly have said so, but no one ever suggested that the treaty suspends the operation of the navigation laws when the coasting trade goes through the canal.*

"The greater discrimination includes the less and as the navigation laws exclude all but American ships from the coasting trade, the grievance of discrimina-

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tion in tolls upon coastwise traffic would seem to be somewhat unreal. If American ships had a monopoly of coastwise traffic when they went around Cape Horn they will have it when they go through the canal, whether or not the canal were American property and whether or not it ran through American territory."

The italics are ours. Certainly no one ever suggested that the treaty suspends the operation of our navigation laws and that view of it alone ought to settle all controversy.

In our opinion, the provision excluding ships owned in part by the railroads from the use of the canal is unwise. It would seem as though the powers of the Interstate Commerce Commission are sufficient to prevent any discrimination in rates against independent water carriers. Moreover, it is to be presumed that the Canadian Pacific and the Grand Trunk Pacific vessels may pass through, as it would be scarcely within our jurisdiction to legislate for other nations.

It is not likely that the provision admitting foreign-built ships to American register when owned by Americans will be taken advantage of to any extent. They could not enter the coastwise trade and their operating costs would naturally be higher under the American flag than under any other flag. The American ship builders protested against the provision, but the president did not think much of it and apparently for that reason.

The canal will be opened to traffic in September, 1913, and the bill at any rate outlines a plan to prepare for the event.

Motor Lifeboats for Ships

There can be no doubt that Lord Mersey's recommendations that the British Board of Trade shall be empowered to direct that one or more of the boats to be carried by ships shall be fitted with some form of mechanical propulsion, will give yet another filip to the motor boat industry. Time and again it has been seen how useful one or more motor lifeboats would be on board passenger liners in cases of emergency. And there is really no reason why an equally useful sphere of operations should not lie before craft of this type in connection with ocean-going cargo steamers. Indeed it is almost impossible to limit the field.

In the case of the Titanic it can well be understood that power boats would have proved of great service in towing other boats away from the sinking ship. Again such a craft, being of considerable power and weight, would almost certainly have been able to rescue many of those who, when the Titanic sank, were left to perish, simply because those in the lifeboats of the ordinary type were afraid to go back to succor drowning people, lest their craft should be overturned.

In the ordinary case of abandonment at sea the motor lifeboat would be sure to demonstrate its undoubted practicability. Suppose, for instance, a ship is abandoned some 300 or 400 miles from shore, and all on board are able to leave her in the boats. If her equipment includes a powerful motor boat, this craft will be able to tow all the boats towards the land. Again, should a ship founder in a stretch of ocean which is some distance from the recognized trade routes, the motor boat could take herself and the rest of the boats to a position where there was more probability of a passing steamer being sighted. While Lord Mersey does not in so many words recommend motor boats, he uses the phrase "fitted with some kind of mechanical propulsion". That, however, can only mean motor boats, for the steam launch could not in a case of sudden disaster be brought into service with the same expedition as the quick-starting motor boat. Such a craft, of course, will need to be carefully looked after by the officers of the ship, but on passenger liners it may be assumed that the strictest orders would be issued from headquarters in regard to the manner in which the efficiency of the motor boat or boats is to be maintained. As a matter of fact, some liners are already using motor craft with excellent results. Lord Mersey's recommendations foreshadow a big demand for motor lifeboats for liners, while it is also possible that cargo steamers will in ever-increasing degree realize their value.

Large Floating Docks

Owing to the recent departure of two large floating docks from ship yards at Barrow and Birkenhead for Montreal and Portsmouth, respectively, there has been aroused a good deal of public interest in floating docks. There has, however, been some confusion as to the size of these docks, one of which has been described as being the largest in the world, which is not correct. The new floating dock at Portsmouth for the admiralty is of just the same size and design as that built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., Wallsend, for the British admiralty, and sent to the river Medway this summer. These twin floating docks, designed to lift battleships up to 32,000 tons displacement, are the largest yet built or owned in Great Britain, but still larger are the 40,000-ton floating dock, owned by the German government at Kiel, and the 35,000-ton dock belonging to Messrs. Blohm & Voss at Hamburg.

PARTICULARS OF SOME OF THE LARGEST FLOATING DOCKS IN THE WORLD.

Dock.	Lifting capacity. Tons.	Length. Ft.	Clear width. Ft.	Depth over keel blocks. Ft.	Owners.
Kiel	40,000	656	154	35¼	German government.
Hamburg	35,000	720	108½	33	Blohm & Voss.
Medway	32,000	680	113	36	British admiralty.
Portsmouth ...	32,000	680	113	36	British admiralty.
Montreal	25,000	600	100	27½	Canadian Vickers Ltd.
Hamburg	25,000	525¾	108½	33	Vulcan Company.
Pola	22,500	584¾	111½	37	Austro-Hung'r'n govt.
Rio de Janeiro	22,000	550	100	30	Brazilian govt.
Hamburg	20,000	511¼	97	26	Reiherstieg Co.

It is astonishing what a volume of business this country is doing, considering the fact that it is a presidential year. Gone are the days when politics disturbed business.

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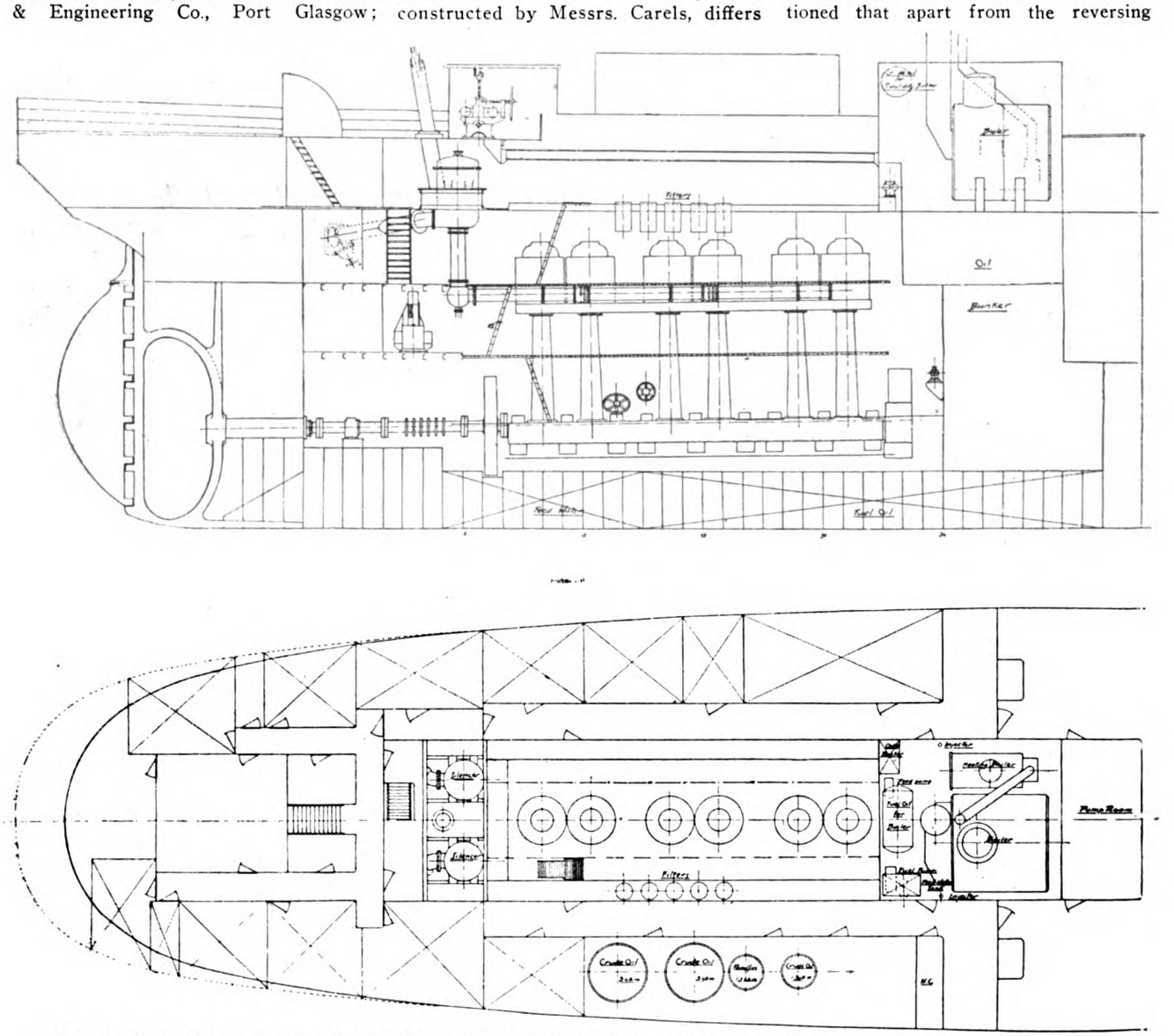
The Carels-Diesel Engine

The Two-Cycle Diesel Engine as Developed by Messrs. Carels—Its Advantages Enumerated

Although there are at present so many builders of Diesel engines, the actual number of types constructed is relatively small, and among these the Carels design will always have a prominent place—more than could possibly be the case were the Carels-Diesel engine built only by the Ghent firm themselves. This is due to the fact that licenses for construction have been granted to many engine builders in all parts of Europe, among whom are such well known firms as Vickers, of Barrow; Richardsons, Westgarth & Co., of Middlesbrough; the Clyde Shipbuilding & Engineering Co., Port Glasgow; Messrs. Stephen & Sons, Glasgow. In Germany, the Reiherstieg Schiffwerfte und Maschinenfabrik, of Hamburg, and J. C. Teckelenborg, A. G., of Bremerhaven, work in connection with Messrs. Carels, as do Schneider et Cie, of Le Creusot, in France. It is not difficult to anticipate that these important firms will in the future years of the rapid development of the Diesel engine produce such a number of motors as will serve as a great monument of the enterprise of the Belgian firms.

The two-cycle Diesel marine engine, as developed and at present constructed by Messrs. Carels, differs considerably from all other types. Our illustration shows a four-cylinder motor designed for 800 B. H. P. to 1,000 B. H. P., and of this type at least four have been already constructed for marine work. The bedplate is in halves, and the cylinders are supported separately by columns, which are flanged and bolted together to form a rigid frame in the manner shown, the feet cast on to the cylinders being bolted direct to broad flanges on top of the columns. The columns on the port side of the ship carry the crosshead guides, which are flat, and it may, incidentally, be mentioned that apart from the reversing



ENGINE ROOM PLANS OF THE CARELS-DIESEL ENGINE SIMILAR TO THE ENGINES INSTALLED IN STEAMER EAVESTONE

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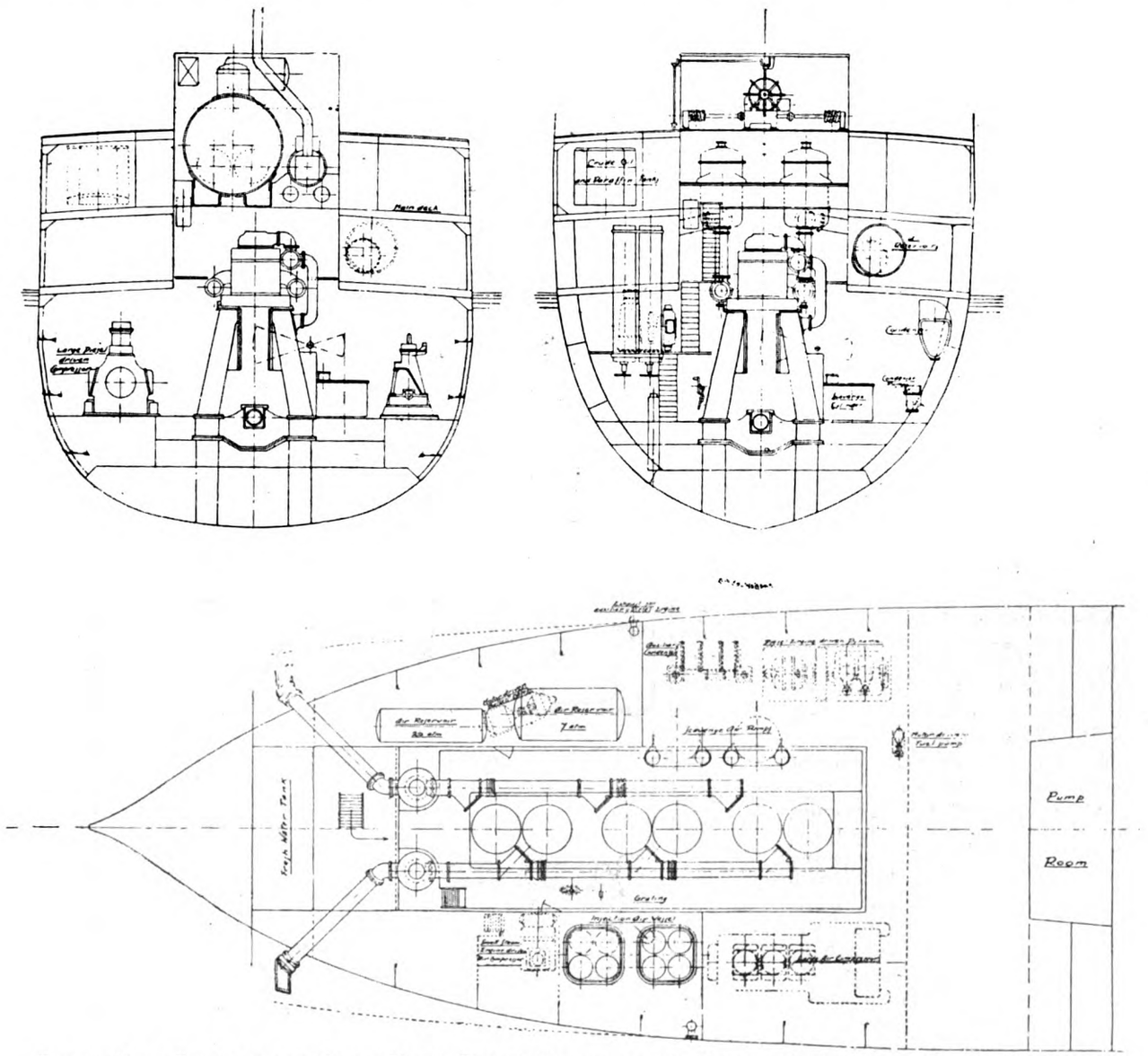
arrangements, this is the only material point of difference in the marine engine from land engines of similar type which Messrs. Carels are constructing, the guides in this case being curved. All marine engines now built by this firm are of the crosshead type, and it seems inevitable that such a design will be generally adopted, except possibly for the high-speed motor, which will always have some vogue, particularly for submarine engines.

The question of the most suitable method of supplying the scavenge air for two-cycle engines is one which has up to now by no means been finally decided. Several firms adhere to the original arrangement of admitting it through valves in the cylinder cover, whilst others prefer to adopt ports in the bottom of the cylinder, opposite the exhaust ports. Messrs. Carels belong to the former category, being of the opinion that such efficient scavenging can never be obtained by the employment of the ports. The contention as to the completeness of the scavenging effect with valves is beyond question, although the advantage in a marine engine of the omission of so many valves as possible cannot be denied, and we understand that the Diesel Engine Co., of London, are now perfecting a design in which both ports and valves are used for the admission of scavenge air. In the engine now being described, four scavenge valves are provided for each cylinder, being arranged symmetrically in the cover, with a fuel valve in the center, whilst there is also a starting valve and a safety valve for each cylinder. All these valves, except the safety valves, are controlled by levers, and actuated by cams in a somewhat similar manner to the working of the valves in the ordinary four-cycle land engine.

Perhaps in no detail of the design of marine Diesel engines is there so much variation as in the reversing gear and its method of operation; this is an extremely good sign, inasmuch as it indicates that there are many very satisfactory arrangements, and there is little doubt that the troubles anticipated on this score have been very much exaggerated. When scavenge valves and not ports are provided, it has been usual to operate these from cams on the same shaft as those for the fuel and starting valves, and for reversing to have two separate cams for operating each valve,



ENGINE ROOM PLANS OF THE CARELS-DIESEL ENGINE SIMILAR TO THE ENGINES INSTALLED IN STEAMER EAVESTONE

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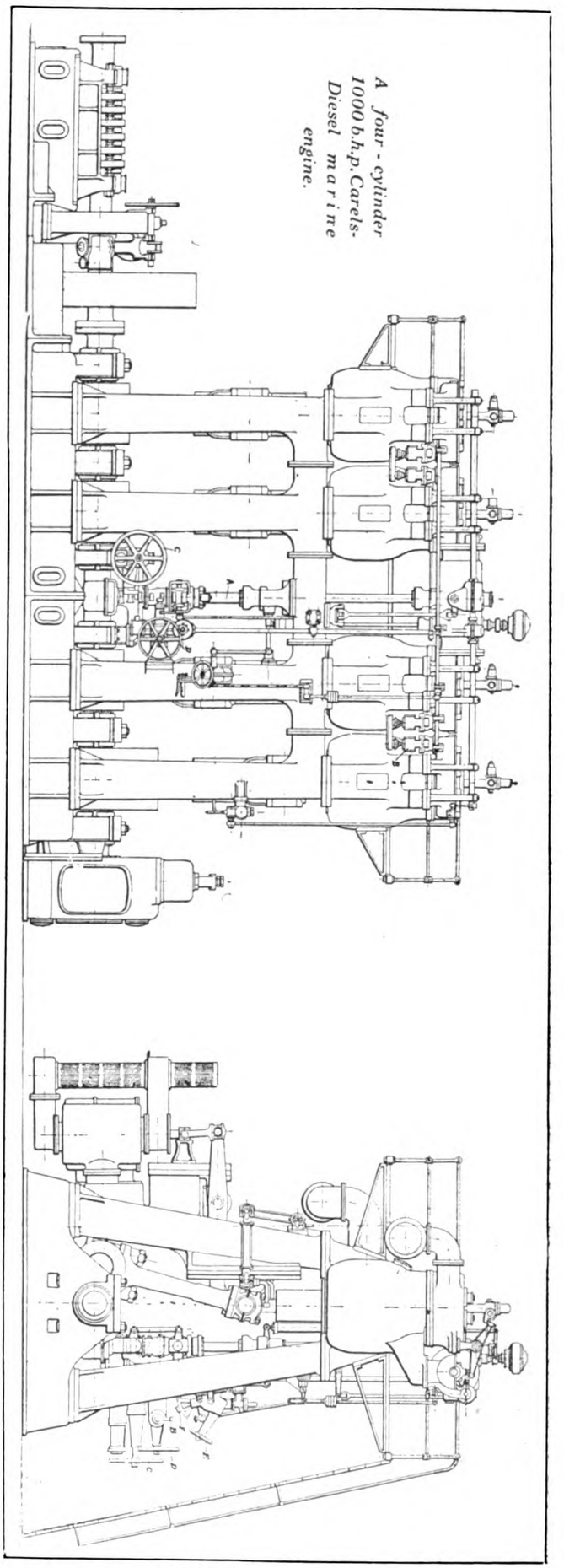
according as the engine is running in the ahead or astern direction. In some designs, reversing is accomplished by employing only one cam for the scavenge air valve, and one for the fuel inlet valve, and arranging the setting of these cams so that by turning the camshaft through a certain angle, relative to the crankshaft, the cams are brought into the required position, but in that case special arrangements must be made for the starting air-inlet valves. If two cams are provided for each valve, and the camshaft is moved longitudinally for reversing, some difficulty arises with the scavenge valve, owing to the presence of compressed air in one or two of the cylinders when the engine stops, and it is evident that a single cam is sufficient for actuating the scavenge air-inlet valve, provided the shaft on which it is mounted is turned through the requisite angle.

Features of Carels Design

In the design adopted by Messrs. Carels, the camshaft is capable of turning through an angle relative to the crankshaft, so that the scavenge valves are set in the position for astern running, and by this means only one scavenge valve is required per cylinder. For the starting and fuel inlet valves, two separate cams, side by side, are provided for each cylinder, and to bring the astern set into action another shaft, directly in front of the camshaft, is moved in a longitudinal direction. This causes the rollers of the fuel and starting valve levers to take up positions above the astern set of cams, on the camshaft, the operation being effected by means of the intermediary levers. The camshaft is driven in a manner similar to that adopted in land engines from the crankshaft, by means of spiral gearing, and the vertical shaft *A*. An ingenious and simple method is adopted of rotating the camshaft relative to the crankshaft, this being accomplished merely by raising the vertical spindle *A*, which is provided with a sort of sleeve coupling. This movement is effected by a small air motor, which is controlled by the lever *B*, whilst in the case of failure of the air motor the operation can be carried out by hand by the wheel *C*. The hand wheel *D* is interlocked with the gear for rotating the camshaft, and can only be moved when this is properly set, and it serves as the maneuvering wheel for starting up the engine and reversing. On turning this hand wheel when requiring to run astern, after shutting off fuel admission, compressed air is first introduced, the motor thus rapidly



A four-cylinder 1000 b.h.p. Carels-Diesel marine engine.

A FOUR-CYLINDER, 1,000 B. H. P., CARELS-DIESEL MARINE ENGINE

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coming to rest, after which it runs up in the reverse direction as an air engine, all cylinders being in operation. The exact arrangement of the fuel admission, which follows, depends on the number of cylinders, but, generally speaking, by a further rotation of the hand wheel *D*, the cylinders are successively supplied with fuel, and admission of starting air is gradually cut off until all the cylinders are running on fuel, the supply of which is gradually augmented until full speed is attained. The whole of this process is rapidly and easily carried out by the hand wheel *D*. The wheel *E* is employed for varying the speed of the engine, by controlling the setting of the governors as required.

The scavenge cylinders, of which there are two in the four-cylinder engine, are of the double-acting type, and their arrangement, as seen in the illustration, differs from that generally adopted in marine Diesel engines. By this method the length of the engine is reduced as compared with design in which the scavenge cylinders are mounted on the bedplate at the end of the working cylinders. In this engine, piston valves are employed for the scavenge pumps, the scavenge cylinder and valve chamber being cast in one piece.

Arrangement of Exhaust Ports

The exhaust ports in the bottom of the cylinders are arranged around the whole circumference, and lead to an annular chamber to which the exhaust pipe is connected. In view of the possibility of exhaust gases leaking past the piston, which is fitted with Ramsbottom rings, a stuffing box is arranged at the bottom of the cylinder, from the center of which any exhaust gas is drawn off to the inlet side of the scavenge pumps, so that no leakage into the atmosphere is likely to occur.

The cylinder cover containing all the valves is of cast steel. The pistons are water-cooled, and it will be interesting to watch developments in this direction, as in some quarters the employment of oil as a cooling medium was originally preferred. The cylinder jackets are water-cooled in the usual way, and mud doors are provided for cleaning purposes, and in this engine the cooling spaces are of specially liberal dimensions—a precaution which is particularly desirable for two-cycle motors. The main fuel oil pumps, of which there is one for each cylinder, are driven off the camshaft, and the governor regulates the distribution of oil in the usual manner, by acting on the suction valves of the pumps. The amount of oil entering the cylinders is also capable of regulation, by means of the small lever *F* seen in the illustration.

The main injection and starting air supply is provided from a three-stage Reavell-type compressor, driven off the end of the crankshaft, whilst at the other end is a large but not particularly heavy flywheel. The compressor is of ample capacity, and is sufficient for the provision of air for all ordinary maneuvering requirements.

The Reiherstieg Engine

One of the first firms to take up the construction of Diesel marine engines, in conjunction with Messrs. Carels, was the Reiherstieg Schiffwerfte und Machinenfabrik of Hamburg, and an engine of about 1,800 H. P. to 2,000 H. P. has been recently built with the co-operation of both firms. It was intended to install this in an existing steam-propelled vessel, the Excelsior, but the owners were unable to lay up the vessel and take out the steam plant, owing to the trade being so busy, and hence a new ship of 7,500 tons dead weight is being constructed and will soon be launched at Hamburg, this being for the German-American Petroleum Co.

The plans which we give are those adopted for the replacement of the steam plant in the Excelsior by Diesel engines, but in the new vessel the arrangements shown will not be materially modified, and where alterations are made they will be beneficial, as naturally it is easier to adapt the general arrangement to a new vessel.

The engine is of a Carels type, following on the lines of the one already described in practically every important detail. There are, however, six cylinders instead of four, arranged in three pairs, and the crankshaft is in three parts, each of exactly the same length, namely, about 12 ft., the diameter being about 14½ in. The advantage of such a construction lies in the fact that only one spare length need be carried. The scavenge pumps are driven by levers from the connecting rods, and each pump is of capacity well in excess of the requirements of three cylinders, so that in the event of breakdown of one scavenge pump, the engine could still run at half-load or over. The diameter of the cylinders is 600 mm. (23⅝ in.) and the stroke 1,100 mm. (43⅓ in.), the maximum speed of the engine for full vessel speed being 100 R. P. M., thus nearly conforming with standard marine-steam-engine practice. It may be interesting to give the overall dimensions of the motor, which are greater than might have been anticipated, owing to the arrangement adopted. The overall length, including the bearings, is about 46 ft. 3 in., the width 17 ft. 5 in., and the total height 23 ft. 6 in.

The weight of the engine itself is just under 300 tons, whilst the auxiliaries are about 220 tons, giving a total weight of machinery of some 520 tons. This is seemingly rather high, and is probably not much less than a corresponding steam-engine equipment. In view of the original intention of the owners to install the motor in an existing vessel, there was, however, but little to be gained in any diminution of weights, and it is, we understand, for this reason that the weight works out at such a relatively high figure. The flywheel is 9 ft. 10 in. in diameter, and its weight is 10 tons, the thrust block, with six collars, being placed just aft of the flywheel. Ring lubrication is provided for the main bearings, whilst for the pistons forced lubrication is adopted.

Engine Exhaustively Tested

The engine has run for some considerable time at the works of the Reiherstieg Co., and has been very carefully and exhaustively tested, whilst inspections have been made by many interested parties, including representatives of the British admiralty. All who have seen it in operation agree that it runs very smoothly and with little vibration, whilst the regulation and reversing are effected with great ease. We understand that the fuel-consumption tests have been satisfactory, he result being that about 0.45 lb. of oil is required per B. H. P. hour at full load. The economy in fuel should therefore be considerable, and there will be a reduction of about 40 per cent in the staff required, as compared with a similar steam ship.

Coming to the general arrangement of the machinery and auxiliaries, a small oil-fired boiler is provided for power purposes, whilst there is a smaller boiler for steam heating, when the first boiler is out of operation. A steam engine, placed well above the engine-room floor, is coupled direct to a compressor, which supplies the compressed air when required for the three-cylinder Diesel engine driving the auxiliary compressor, and this delivers the air to the main engines for starting-up purposes. Both these auxiliaries are very rarely required to be put into operation, since the main compressor, in combination with the air reser-

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voirs, is usually sufficient. This main compressor is of the Reavell type, and is driven direct off the main engine in the ordinary manner. The dynamo for the ship's lighting, etc., is driven direct by a four-cycle Diesel engine, this dynamo also providing the electric power for one or two motors, the ballast pump, the oil pump for the main engine, and that for the boiler, all being electrically operated. Two air reservoirs are provided, one of about 80 cu. ft. capacity for a pressure of about 290 lb. to 300 lb. per sq. in., and the other of about 200 cu. ft. capacity for a pressure of 100 lb. per sq. in. For the sake of economy, and to avoid running the donkey boiler more than necessary, the steering engine is operated by compressed air when the ship is at sea, but is driven by steam when near land, whilst there is a larger oil pump, also steam driven, this only being occasionally required.

First British Owned Diesel Engined Ship

Messrs. Furness, Withy & Co.'s new Diesel-engined ship Eavestone has carried out her preliminary trials, and, judging from results attained, the builders and engineers, Messrs. Richardson, Westgarth & Co., Middlesborough, have turned out in her a big success. The Eavestone is a vessel of 3,600 tons dead weight carrying capacity, and is 276 ft. in length by 40 ft. 6 in. molded beam. She is the first really large British-owned Diesel ship to be built, and accordingly a vessel to which the greatest interest is attached. Her engines take the form of a four-cylinder two-stroke set made by the well known Middlesborough firm under license from Messrs. Carels Freres, of Ghent. The service speed of the engines is only 115 R. P. M., which allows of splendid propeller efficiency and at this speed over 850 B. H. P. is developed. This Carels engine of the Eavestone is practically a duplicate of the 850-H. P. Carels engine just completed by the Clyde Shipbuilding & Engineering Co., Port Glasgow, for the American Lakes vessel Fordonian, which they recently launched, and is an engine of simple construction and not at all unlike the usual steam reciprocating installation. In the Carels Diesel engine there is the open crank pit, the box columns giving support to the cylinders, and the open crossheads working the air scavenging pumps in similar fashion to the air pumps on a steam engine. During the trials of the Eavestone the engines were kept running at full load for over nine hours, during which time no trouble of any kind was experienced, the fuel used being heavy residue oil.

No type of oil engine is commanding more attention in Britain for big ship propulsion than the Carels; indeed, at the present time the majority of motor ocean-going vessels under construction are to be so fitted.

As compared with a sister ship driven by steam engines, the extra space avavilable for cargo on a 30 days' trip amounts to no less than 400 tons.

It is hoped that, in due course, a special trip will be arranged when those interested in the advent of the first British-owned oil-engined ship will have an opportunity of inspecting in London the latest design of Diesel marine engine.

The Eavestone took a cargo of coal from West Hartlepool, England, to Antwerp on her maiden trip. During the run of 37½ hours no trouble developed; there were no stops and no heat in the engine room. The Eavestone returned to West Hartlepool light against heavy head winds and without a stop. The governor was set for 86 R. P. M., and when the propeller was thrown out of the water the maximum speed was 92 revolutions, coming back to 86 revolutions in less than five seconds.

Carels-Diesel Ship for Great Lakes

Considerable interest was evinced in the launch on July 3 from the yard of the Clyde Shipbuilding & Engineering Co., Port Glasgow, of the motor-driven ship Fordonian, intended for passenger and cargo service on the Great Lakes of America. This packet-freight steamer, which is the first of her type to be constructed in the Greenock district, is of the following dimensions: Length, 250 ft.; breadth, 42 ft. 8 in.; depth molded, 16 ft. 10 in. to the main deck, and 26 ft. 6 in. to the awning deck. She is thus an ordinary type of vessel, but her engines are, however, very interesting, and on this particular point she is a vessel of no small importance. Unlike the twin-screw motor liner Jutlandia, built and engined by Messrs. Barclay, Curle & Co., Whiteinch, the Fordonian is a single screw ship, and is not fitted with four-cycle engines, as was the case with the Whiteinch vessel, but has an 800 B. H. P. four-cylinder Carels-Diesel two-cycle set. Each of the 8-cylinder twin Burmeister and Wain engines of the Jutlandia developed 1,270 H. P., or about 160 horsepower per cylinder. The Fordonian's engines, however, are designed for 200 B. H. P. per cylinder, and will no doubt give more, and are, therefore, built up of the highest-powered units yet seen in the British marine heavy oil engine. In some quarters it was said that the engines of the Fordonian were being built by Messrs. Carels Freres at Ghent. This is not the case, and all the credit goes to the Port Glasgow firm as with the exception of the cylinders, which were cast and bored at Messrs. Carels' works, the machinery was turned out complete by the Clyde company.

The Fordonian has been built under Lloyd's survey. A noticeable feature of the design of oil motor-driven vessels is that the machinery space is only about one-third of that which is necessary for steam engines, and the absence of boilers and boiler casings leaves a large amount of hold space for the cargo, and for more deck space for the use of passengers than would be possible with steam engines. A motor ship has also considerable advantages over the equivalent steamship; there is more economy in fuel in the former type of vessel, while she requires no stokers or coaling, and there are no stand-by losses when not under way, and no discharge of ashes, and an important matter for passengers and cargo is the absence of heat. A most important fact is that the Fordonian will have a radius of navigation on the same bunker capacity of at least four times that of steam and she will be able to effect an immediate starting against a 24 to 30 hours' delay in getting up steam.

Large Carels Marine Diesel Engine

Editor MARINE REVIEW:—On Saturday, July 29, the writer visited the works of the Reiherstieg Schiffswerfte und Maschinenfabrik, Hamburg. I saw the six-cylinder 1,800 H. P. Carels marine setting on frame work and not at all bolted. This engine had been idle for several days when the writer witnessed their opening the valves, preparing the lubricating and circulating systems, and by a small turn of the hand on the operating lever, this massive engine started and went to its full speed in less than 5 seconds.

The operator, still standing in the same position, reversed the engine from full speed ahead to full speed astern in 9 seconds, he, then, by still handling the same lever maneuvered the engine for a wide range of speeds with great ease.

The engine is self-contained, the injection air compressor is connected to the fore-end of the engine, where the scavenging air cylinders, the cir-

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culating water pumps, the bilge pumps and an air cylinder, which will develop air for maneuvering the ship, are all connected to back of the engine frame and operate by levers from the connecting rods. This makes a compact arrangement and works very successfully. This simplicity of the water pumps and air pumps I consider a great attainment in the application of the Diesel engine to marine service.

The temperature created by the operation of the engines is hardly perceptible on the outside of the engine, as they circulate the necessary volume of water to keep all parts, including valve cages, perfectly cool. They have a mechanism of pumps attached to each piston which circulates through the inside of the piston to keep it cool. This is a piston pump positive in its action and having no flexible joints or parts liable to get out of working order.

The lubricating of the engine is very positive and successful.

The reversing of the engine is simple and all on the outside is subject to a minute inspection at any time when the engine is in operation. When in operation, this 1,800 H. P. engine creates so little noise in the engine room that it can be considered almost silent, as the operators can talk to each other in a normal tone without any difficulty.

The writer was surprised at the lack of vibration in this engine when operating under various loads and reversing; as stated above, the engine was not anchored to the foundation or solid matter that would tend to eliminate the vibration, but its bed-plate was simply resting on I-beams, lying on the shop floor.

The design of the engine is exactly that of a standard marine steam engine with large cast iron columns resting on a heavy base, the shaft and main bearings, the connecting rods with both crank and piston bearings are exactly marine practice. In fact in the same shop there was being assembled a large quadruple expansion steam engine, which to the layman would appear to be the same in every respect as the large Diesel engine with the exception of the working of the valves and rods.

The object of the builders appears to have been to build a marine Diesel engine as near like a marine steam engine as possible, and they have certainly succeeded well.

This two-cycle marine type Carels engine is far superior to the four-cycle type marine engine, especially in the feature that it is an open frame, simple in design as compared with the other being a closed case with many complications in the working parts subject to getting out of working order.

This engine is seriously worth all consideration by all builders of ships at this time.

The engine has been developed in a range of sizes and can be made in 4, 6 and 8 cylinders as desired.

W. R. HAYNIE.

Steamer Thompson Leaves for Coast

The steamer Robert M. Thompson, the first of three ships building by the Great Lakes Engineering Works, of Detroit, Mich., from designs by and under the supervision of Theodore E. Ferris, naval architect and engineer, of New York, for the American Transportation Co., J. W. Elwell & Co., agents, left for the coast during the past month after completing a series of trials on Lake St. Clair, to the satisfaction of both builders and owners. Her sister ships, the A. A. Raven and Ruby, will follow in a month or six weeks. The vessels are the most modern of freight carriers, having a double bottom, 'tween decks, cargo ports with excellent cargo handling facilities. Their dimensions are 261 ft. over all; 241 ft. keel; 43 ft. 6 in. beam, and 29 ft. deep, having carrying capacity for 4,000 tons on deep sea draught. The engines are triple-expansion 21½, 35½, 58 in. cylinder diameters by 42 in. stroke, supplied with steam from two Scotch boilers 14 ft. 2 in. diameter and 12 ft. long, fitted with forced draught.

The Thompson was given quite an ovation as she proceeded to the coast and she was royally received upon her arrival at New York. The South Brooklyn piers were decorated in her honor and a banquet was given aboard her, which was presided over by D. H. E. Jones, who was directly responsible for the organization of the new company. Mr. Jones related that he had always been keen to own an American-built vessel to engage in foreign trade. It is the intention to operate the new fleet under the American flag to Mediterranean ports. J. W. Elwell & Co. have long operated vessels in the foreign trade under foreign flags. However, the Thompson is the first to fly the Stars and Stripes.

"The freight market is so good," said Mr. Jones, "that steamers flying the American flag can compete with foreign carriers to foreign ports at a profit. I expect this condition to continue for some time. There is a great scarcity of tonnage, both here and abroad, and English as well as German shipyards are crowded with orders. The coming year will witness an immense increase in America's little merchant marine.

"When the Robt. Thompson sails in September for the Mediterranean, she will be the first American ship to enter that trade route for 35 years, when foreign competition drove us away. The ships we have operated since, have been French vessels with French officers and crew. Those we have built on the Great Lakes will fly the Stars and Stripes and will be commanded by American captains and manned by an American crew."

Another Unloading Record

Unloading records are following fast upon each other at Conneaut. One is no sooner established than it gives place to another. The records made on the Palmer and Morgan as chronicled in the August issue of THE MARINE REVIEW, were broken by the steamer P. A. B. Widener on Aug. 8, when 10,636 gross tons of Pioneer ore were discharged in two hours and 50 minutes. It is significant also that the entire cargo of the Widener was loaded into cars. It can be appreciated from this that very efficient car service is necessary to prevent delays at the unloaders when the ore is being lifted from the hold of a vessel at such a rate. The Widener began unloading at 2:20 P. M. and finished at 5:10 P. M., the elapsed time being 2 hours and 50 minutes. The details of the unloading follow:

	Tons per hour.
For nine machines (gross ves. time).	3,754
For nine machines (gross mach. time)	3,847
For nine machines (net mach. time)	4,037
5,229 tons were unloaded by four Hulett steam machines.	
For one machine, gross time.....	482
For four machines, gross time.....	1,927
For one machine, net time.....	508
For four machines, net time.....	2,034
3,538 tons were unloaded by four Brown electric machines.	
For one machine, gross time.....	315
For four machines, gross time.....	1,260
For one machine, net time.....	336
For four machines, net time.....	1,344
1,869 tons were unloaded by Hulett electric machines, as follows:—	
Gross time	660
Net time	660

Lake Ship Building

Capt. John Mitchell has placed an order with the American Ship Building Co. for a bulk freighter to replace the James Gayley which was sunk in collision with the steamer Rensselaer 43 miles east of Manitou Island, Lake Superior, during a dense fog on Aug. 7. The Gayley was struck immediately abaft the forward deck house and sank in fifteen minutes in 600 ft. of water.

The new steamer ordered will be somewhat larger than the Gayley, being

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545 ft. over all, 525 ft. keel, 58 ft. beam and 31 ft. deep, and will carry 10,000 gross tons. She will be built at the Lorain yard of the American Ship Building Co. and will be delivered next spring. She will be constructed on the Isherwood system and will have straight side tanks.

Following the practice to avoid litigation, if possible, the Pittsburgh Steamship Co. which owns the Rensselaer and the Cleveland Steamship Co. which owned the Gayley, have settled their differences upon an equal division of the damage. The Gayley was valued at $250,000.

The steamer George T. Warren, building for the Boston & Virginia Transportation Co., Boston, was launched at the yard of the Toledo Ship Building Co. on Aug. 21. The steamer is of Canadian canal dimensions and is intended for service on the coast.

The Great Lakes Engineering Works launched the steamer Ruby for the American Transportation Co. of New York on Aug. 21. This steamer is also of Canadian Canal dimensions and is intended for coastwise service. She is the last of the three steamers building for this company to be launched.

The 600-ft. steamers building by the American Ship Building Co. for the Pittsburgh Steamship Co. will be named James A. Farrell, Percival Roberts, and Richard Trimble. The Farrell will go overboard at Lorain on Sept. 28.

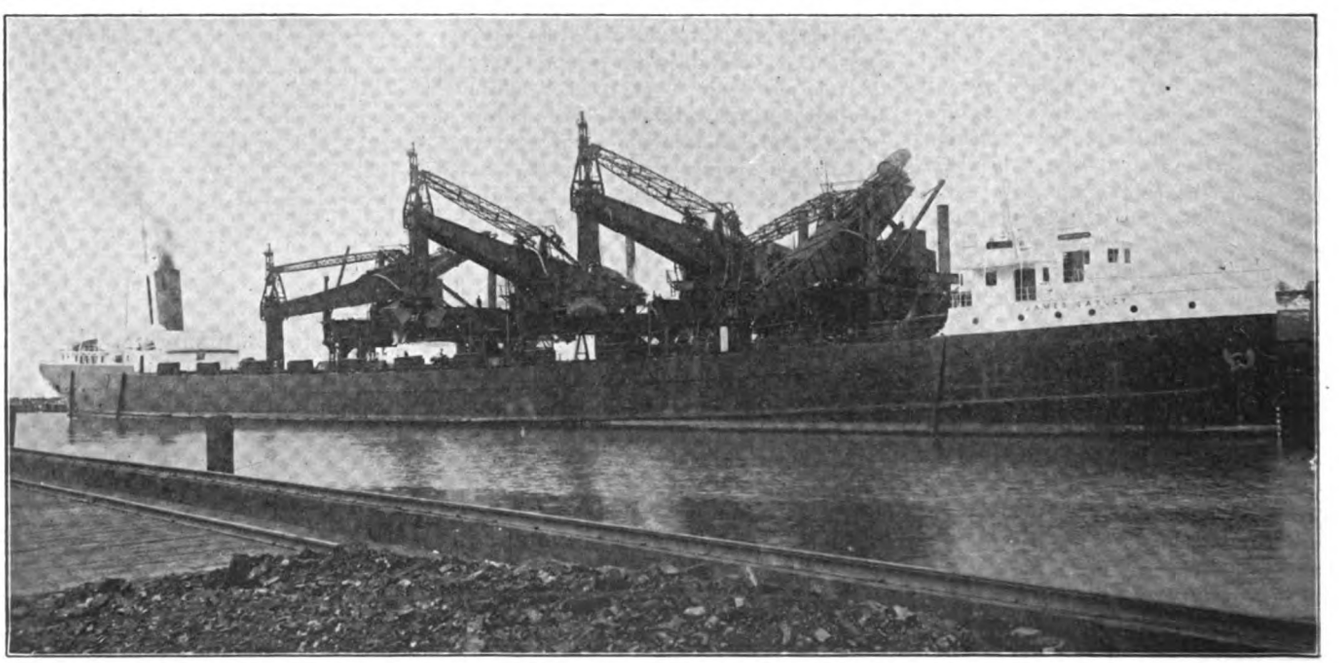
The steamers E. A. S. Clarke and William E. Reis, managed by Capt. John Mitchell of Cleveland, are being remodeled at the yard of the Toledo Ship Building Co. They will be given side tanks and 12 ft. center hatches after modern practice.

First Automatic Unloading

The loss of the steamer James Gayley on Lake Superior last month recalls the fact that it was the maiden trip of the Gayley that marked the coming together, so to speak, of the modern ore unloader with the modern type of vessel constructed especially for automatic unloading. James Gayley, at that time vice president of the United States Steel Corporation, in whose honor the steamer was named, had manifested a keen interest in ore transportation facilities and in loading and unloading docks and it was his suggestion that 'tween deck beams and stanchions were eliminated or their use greatly minimized in the construction of the Gayley. The merit of the new construction was demonstrated when the Gayley unloaded her maiden cargo, 95 per cent of it being automatically unloaded. The Gayley on that occasion carried 6,088 gross tons and unloaded on May 27, 1902, at the Hulett 10-ton unloading plant at Conneaut. There was considerable opposition to the design at the time. Within two years thereafter practically all bulk freighters on the lakes were being built with 'tween deck beams and hold stanchions entirely eliminated, and with the further advantage of having their hatches space 12 ft. centers instead of 24 ft. centers. This rapid change was brought about by the practical demonstration by the Gayley that her ore cargo could be automatically discharged without a man in the hold of the ship.

Lake Trade

The lake situation is better than it has been at any time during the past three years. The trade is apparently booked for one of its old time finishes with everyone eager for tonnage and paying good prices to get it. The movement of ore, as will be noted in the ore shipments elsewhere, is the heaviest on record and while it has been almost exclusively carried in contract ships, ore shippers could nevertheless employ additional tonnage if they could get it. The grain rate, however, is working out at quite an attractive figure so that vessel owners are quite reluctant to take any additional ore at the established contract rate of 40 cents. Of course, it is probably true that large ore shippers could get tonnage at the contract rate if they wanted to, but the smaller ore shipper cannot. In fact, a Buffalo concern has been trying to get tonnage for some little time at an advance of 10 cents without any takers. The reason is that the grain rate is extremely attractive, working out during the first half of September at 93 cents on ore and calculated to go considerably higher. In fact, it is predicted that by October 1 the grain rate will be equivalent to $1.20 on ore. Practically all vessels are employed and there appears to be



STEAMER JAMES GAYLEY DISCHARGING MAIDEN CARGO (6,088 GROSS TONS) OF IRON ORE MAY 27, 1902, AT AUTOMATIC UNLOADERS, CONNEAUT, O.; 95 PER CENT AUTOMATICALLY UNLOADED

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plenty of business for everyone. This is indeed in strange contrast to the experiences of the past three years when vessels had to go into voluntary retirement early in the year and some in fact were not operated at all during the entire season.

A contributing reason has been the continued thick weather. Practically the whole of August was one of fog and all vessels were delayed. As an offset to this is the incredible efficiency of the unloading machine. When 10,600 tons can be taken out of the hold of a steamer in less than three hours and loaded into cars, dispatch may be said to have reached its maximum, but as a matter of fact, records are being broken all the time.

Commerce of Lake Superior

The commerce of Lake Superior for August as measured by the canals at Sault Ste. Marie was the heaviest of the year, reaching 10,852,852 tons as against 10,781,504 tons for July and 10,747,159 tons for June. The movement to Sept. 1 of the present year totals 41,484,926, as against 31,488,323 for 1911, and 40,046,800 for 1910, a gain of 1,438,126 tons over the record movement of 1910. Following is the summary:

	To Sept. 1, 1911.	To Sept. 1, 1912.
East Bound.		
Copper, net tons	71,078	60,772
Grain, other than wheat bushels	18,418,257	25,046,811
Building stone, net tons	4,137	2,282
Flour, barrels	3,454,630	4,029,959
Iron ore, net tons	18,683,240	27,749,944
Pig iron, net tons	17,784	11,974
Lumber, M. ft. B. M.	328,329	387,691
Wheat, bushels	34,078,649	60,866,933
Unclassified freight, net tons	79,453	128,196
Passengers, number	30,276	25,264
West Bound.		
Coal, anthracite, net tons	1,226,515	926,926
Coal, bituminous, net tons	8,116,034	8,063,394
Flour, barrels	125	.....
Grain, bushels	1,100	100
Manufactured iron, net tons	242,900	366,989
Iron, ore, net tons	12,622	3,188
Salt, barrels	382,826	405,742
Unclassified freight, net tons	732,632	748,628
Passengers, number	35,130	27,533
Summary of Total Movement.		
East bound, net tons	21,100,586	31,315,627
West bound, net tons	10,387,737	10,169,299
Total	31,488,323	41,484,926

The total number of passages to Sept. 1, 1912, was 13,330, and the net registered tonnage, 32,896,057.

August Ore Shipments

Ore shipments during August amounted to 7,760,248 gross tons, the highest record of the year, and making the third month in which the 7,000,000-ton mark has been exceeded. During June last the fleet moved 7,600,283 tons, in July 7,567,555 tons, and as stated, in August 7,760,248 tons. This movement was carried practically in contract ships, though the ore shippers would have been glad to charter more wild tonnage, if possible. However, the grain trade has been so attractive that there is little outside tonnage to be had. The movement to Sept. 1, is 29,051,152 tons as against 19,606,068 tons to Sept. 1, 1911, an increase of 9,445,084 tons. The August movement marks the passing of the 1910 record when up to Sept. 1, 28,827,029 tons were moved during that year. The increase over 1910 to Sept. 1 is therefore 224,123 tons.

Following is the summary by ports:

Port.	August, 1911.	August, 1912.
Escanaba	706,445	761,717
Marquette	357,571	570,586
Ashland	407,578	761,539
Superior	1,689,952	2,397,535
Duluth	1,211,667	1,690,650
Two Harbors	1,175,098	1,578,221
Total	5,548,311	7,760,248
1912 increase		2,211,937

Port.	To Sept. 1, 1911.	To Sept. 1, 1912.
Escanaba	2,418,251	3,240,011
Marquette	1,200,748	2,031,400
Ashland	1,509,841	2,865,397
Superior	6,382,273	9,066,190
Duluth	4,370,117	6,076,452
Two Harbors	3,724,838	5,801,702
Total	19,606,068	29,051,152
1912 increase		9,445,084

Lake Ore Receipts

Out of total ore shipments of 7,760,248 gross tons during August, Lake Erie ports received 6,075,673 tons, distributed as follows:

Port.	Gross tons.
Buffalo	802,367
Erie	62,274
Conneaut	1,303,982
Ashtabula	1,305,840
Fairport	375,373
Cleveland	1,291,831
Lorain	637,388
Huron	78,100
Sandusky	.....
Toledo	141,145
Detroit	77,373
Total	6,075,673

Floating Dry Dock at Toronto

The Polson Dry Dock & Shipbuilding Co. Ltd., of Toronto, has begun the construction of the first steel floating dry dock built in Canada. The dock will be located at the foot of Sherbourne street, and will be of the sectional "U" type, and was designed by William Newman, works manager. The plans have been approved by the Canadian government, by which the work is liberally subsidized.

The dock is to be 330 ft. long by 100 ft. wide and 35 ft. 4 in. deep, and 72 ft. wide on deck, 88 ft. wide on top with 8 ft. 6 in. depth of hold, to be built in two sections of equal heights, weighing approximately 2,400 tons with a lifting capacity of 4,400 tons. The pumping equipment consists of twelve 12-ft. centrifugal pumps with a capacity of 42,000 gallons per minute, in batteries of three in each quarter of the dock, each battery driven by a 75-H. P. direct-connected motor and all pumps controlled from a central station ashore. The construction of the pumping equipment consists of one longitudinal water-tight bulkhead amidships and a transverse water-tight bulkhead every 50 ft., dividing the dock into twelve compartments each 50 ft. square with a pump in each. The discharge and flooding of the dock is all through one valve at each pump.

Germans on the Titanic Disaster

Cable dispatches announce that the commanders of German trans-Atlantic liners practically all agree that under similar circumstances with those obtaining at the time of the Titanic disaster they would not have reduced speed. They maintain that with a proper lookout there would be ample time to avoid a collision with ice. The German view is that Capt. Smith's lookout failed him.

The steamer William A. Rogers of the Niagara Transit Co.'s fleet was in collision with Standard Oil Co.'s barge No. 96 off Whitefish Point on Sept. 2 during a dense fog. The barge was being towed by the tug Security when the Rogers crossed the tow line, causing the barge to take a sheer into her. The Rogers returned to the Sault for an examination where it was found that her bow had been crushed in almost to the collision bulkhead. Her stern is also twisted and it will take about three weeks to repair her. She is now in dry dock at Superior.

The Montreal Transportation Co. through John Reid & Co. of Montreal have placed contract with Swan, Hunter & Wigham Richardson for a steamer for service on the great lakes to be electrically driven. She will be equipped with internal combustion oil engines connected to dynamos and the electric power thus generated will be transmitted through motors to the shaft.

The Homestead Valve Manufacturing Co., Homestead, Pa., recently issued catalog and price list of their complete line of valves. The catalog is very instructive, giving description of the various types of valves illustrated with sectional views.

The Kenyon Searchlight Co., formerly of Bedford, O., has reorganized with offices at Detroit, Mich. Its facilities are largely increased and it is now in position to meet all requirements for all styles of portable searchlights.

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Naval Tugs Sonoma and Ontario

The New York Ship Building Co., Camden, N. J., has just completed for the United States navy department, the steel ocean-going tugs Sonoma and Ontario, ordered by the United States government, Aug. 24, 1911, and launched, the Ontario on April 11, 1912, and the Sonoma on May 11, 1912. These tugs are of the single-screw type and have the following dimensions: Length over all, 185 ft. 2 in.; length between perpendiculars (fore side of stem to after side of rudder post), 175 ft.; beam, molded, 34 ft.; beam, over guards, 35 ft. 6 in.; depth, molded, to main deck, 20 ft. 3 in.; mean load draught (salt water), 12 ft. 6 in.: speed, loaded, at sea, 14 knots.

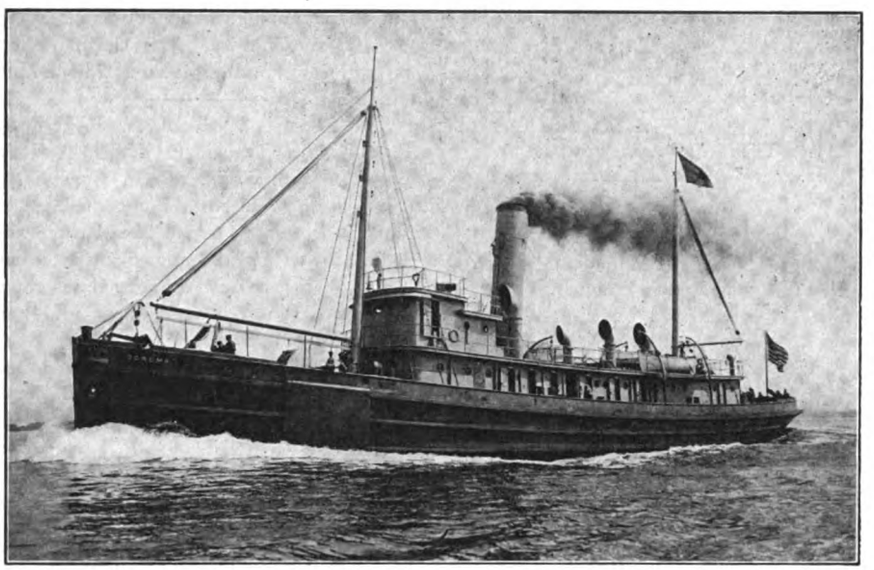
The vessels are of open-hearth steel throughout, and built in accordance with the rules of the American bureau of shipping and under special survey. They are subdivided by seven watertight bulkheads, and have raked stem and elliptical stern, two masts with derrick boom of 5-ton capacity on fore mast, schooner rig and equipped with a wireless outfit. These tugs are very large and powerful, being well adapted for the work they will be called upon to do in the event of war.

Quarters for a naval complement of four officers, three chief petty officers and 35 men, are arranged as follows: Captain's quarters aft of the pilot house, officers' quarters in forward end of main deck house, crew on lower deck, forward; chief petty officers and engine room force on lower deck, aft; toilets, galley, etc., forward of engine space, in main deck house. There is fitted forward a steam windlass, combined with towing bitt, the windlass having warping ends. A reversible capstan is fitted on main deck aft. Two steam winches of 5-ton capacity each are located, one at fore mast on main deck, the other at the main mast on top of the deck house. A towing machine is provided in the after end of the main deck house and supplied with necessary hawser rollers, etc., a towing bitt is also fitted aft, a steam steering engine is located in engine room and has connection in pilot house. A combined steam and hand steering wheel is fitted on after end of deck house top.

The boat equipment consists of one 21-ft. motor dory, one 28-ft. whale boat and one 16-ft. dinghy; the former two being slung under davits. One 4-in. Monitor fire hose nozzle is fitted on top of pilot house and a similar one on top of deck house aft. A machine shop, amply equipped, is located upon platform on port side of engine room. Double bottom and feed-water tanks are fitted under boilers.

The peak tanks are arranged for the carrying of fresh or salt water and the coal bunkers are abreast of the boiler room, with a cross bunker aft of the boiler room. The drinking water tanks contain 4,000 gallons of fresh water and the gravity tank 500 gallons. The refrigerator space has a capacity of 550 cu. ft.

The propelling machinery is placed amidship and consists of two single-ended Scotch boilers, arranged fore-and-aft, with fireroom between the two. They are 16 ft. in diameter and 11 ft. between heads, with a working pressure of 200 lb. The engines are of the vertical, inverted-cylinder, triple-expansion, surface-condensing type, of about 1,800 horsepower, with cylinders 19¾, 31½ and 54¼ in. diameter by 36-in. stroke. The contract price of each tug is $194,000.



NAVAL TUG SONOMA ON HER TRIAL
Photo by New York Ship Building Co.

Launch of the Nelson

The steamer Nelson, building by the Fore River Ship Building Co., of Quincy, Mass., for the Cuba Distilling Co., of Havana, Cuba, was launched on Monday, Aug. 12, the christening ceremony being performed by Miss Madeline E. Mayer, daughter of Mr. and Mrs. Levy Mayer, of New York.

The Nelson is an improved duplicate of the steamer Currier, built by the Fore River Ship Building Co. and owned by the Cuba Distilling Co., and will be engaged in the transportation of molasses in bulk between Cuba, Porto Rico and American ports, principally New York. She is also constructed in such a way as to enable her to enter the trans-Atlantic trade.

The principal dimensions are as follows:

Length between perpendiculars, ft.....	370
Beam molded, ft.....	52
Depth molded to upper deck, ft.....	30
Draught loaded, ft.....	23
Gross tonnage, about	4,700
Net tonnage, about.....	2,800

The vessel can be used for the transportation in bulk of molasses, oil, or other liquid cargo. The total stowing capacity for molasses is 190,000 cu. ft., representing over 1,400,000 gals. When carrying petroleum, with the oil carriage and tanks and inner bottom, the vessel will have a capacity of 1,600,000 gals.

The vessel has three pole masts fitted with cargo booms having a capacity of 5 tons each. The propeling machinery is located in the stern of the ship, consisting of a vertical inverted three-cylinder, triple-expansion engine with cylinders 25 in., 41 in. and 68 in. and a common stroke of 48 in., supplied with steam at 190 lbs. pressure by three single-ended Scotch boilers, working under the heated forced draft system. The engines will develop a maximum of 2,700 H. P., which will give the vessel a speed of more than 12 knots.

The Main St. Iron Works, 163-173 Main St., San Francisco, Cal., have under construction two passenger steamers for Charles R. McCormick & Co., and a freight steamer for the Southern Oregon Transportation Co.

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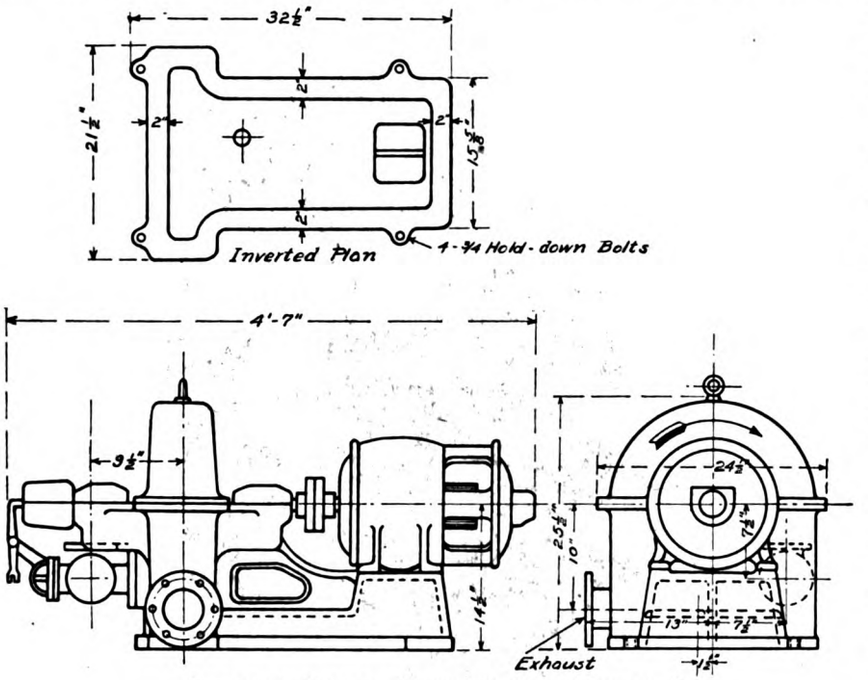
Interesting Marine Electric Lighting Sets

Eight turbo generator sets each with a normal capacity of 10 kilowatts, have recently been supplied to the Erie Railroad Transit lines for use on their great lakes steamers by The Terry Steam Turbine Co., of Hartford. The necessity for light weight in marine work, together with ample rigidity, was the principal factor of consideration in the design of these outfits. The weight of the combined unit, including turbine and generator, is only 1,100 lb., or 110 lb. per kilowatt.



SECTIONAL PLAN OF TERRY TURBINE LIGHTING SET

In some cases for electric light work machines of the so-called four-bearing type have been used. However, the necessity for decreasing the overall length as much as possible and the maintenance of true alignment has led to the present development of the three-bearing type of unit. In this type the sub-base for the generator is integral with the turbine base proper, eliminating the possibilities of misalignment. The turbine and generator rotors are substantially on the same shaft, being connected by a solid coupling which enable either the turbine or the generator to be easily taken apart without dismantling the whole machine.

Six of the sets in question are designed to operate with a steam pressure of 125 lb. with a maximum of 150, while two of them are designed for steam pressure of 100 lb. The machines are all run non-condensing and the guaranteed output is maintained with a back pressure of 5 lb. gage.

The turbines themselves are of the well-known Terry single stage type, the best workmanship possible being put into the entire machine. All rotating parts are liberally designed to insure absence of whipping, and are very carefully balanced, both statically and running at full speed, to eliminate the possibility of vibration.

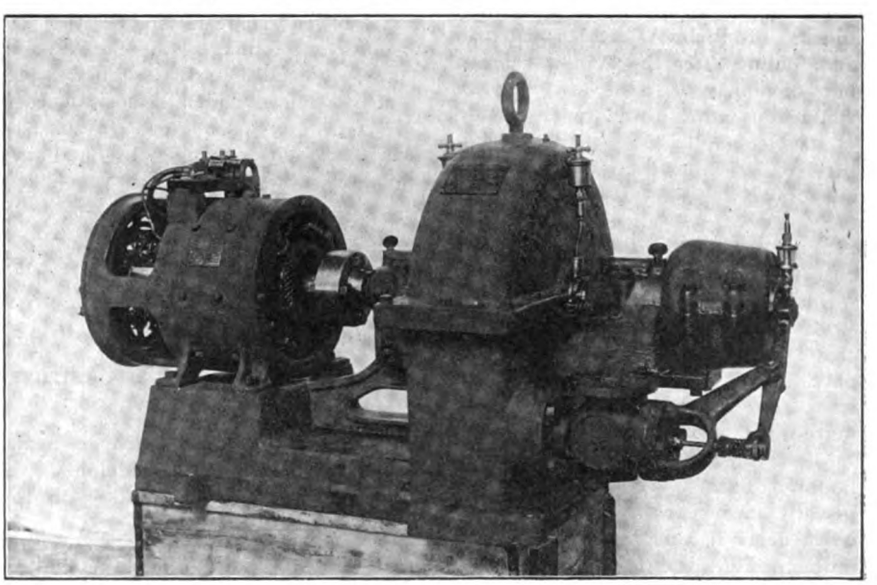
The generators are compound wound for 125 volts and are guaranteed to run at full load for 24 hours continuously with a rise in temperature not exceeding 40 degrees in the armature and 45 degrees in the commutator when run for two hours. The generator efficiency at full load and 25 per cent overload was guaranteed at 86 per cent.

A thorough test of all these sets was conducted at the makers' works before shipment, the tests on two of these machines being witnessed by the consulting engineers of the steamship line, on March 1 last. The summary of one of the tests witnessed follows:

Throttle pressure, pound, gage.....	149.4
High pressure inlet, pound gage....	114.8
Back pressure of exhaust, gage....	5
Quality of steam by calorimeter....	.994
Revolutions per minute.....3,200	
Volts at terminal.....	123.3
Amperes at terminal	86.8
Load in kilowatts.....	10.4
Total pounds steam per hour.....	779
Total pounds dry steam per hour...	775
Pounds steam per kilowatt hour....	74.7
Pounds dry steam per kilowatt hour	74.25
Duration of test.....	1 hour
Momentary speed variation, full load thrown off, per cent.....	2.18
Settled speed variation, full load thrown off, per cent.....	0.96

The figures on all the machines were inside their guarantee by a liberal amount. The speed regulation on these machines is deserving of special mention. The mean settled speed variation on the whole eight machines was 1.3 per cent with a momentary speed variation on the worst machine of 5 per cent and an average momentary jump on all the machines of 2.66 per cent.

The general appearance and the small amount of room which they occupy is well shown by the accompanying illustration, the overall dimensions of which will be seen to be 4 ft. 7 in. length, extreme width 2 ft. 1½ in., and the extreme height 2 ft. 1½ in.



10 K. W. TERRY TURBINE-DRIVEN LIGHTING SET FOR ERIE RAILROAD TRANSIT LINE'S VESSELS

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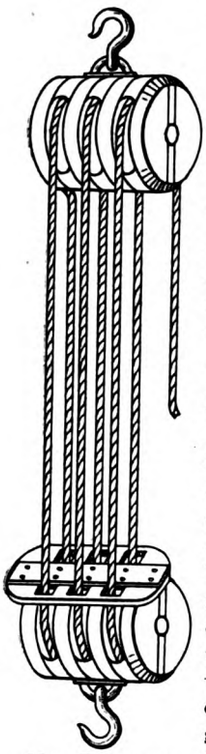
Star Non-Toppling Block

The Star non-toppling block and the Raymond releasing hook combined practically solve the principal difficulties of lifeboat launching and hoisting out. The merits of the Raymond releasing hook are well established and it is in use on practically 75 per cent of ocean and lake passenger vessels, as well as on a great many freight boats engaged in ocean and coastwise traffic. It is the only device for the purpose intended used in the United States navy and it forms part of the equipment of the vessels of the various departments of the United States government. The Star non-toppling and anti-fouling block device is new. It is easy to attach to blocks already in and is low in price. It was primarily designed to remedy the trouble and danger incidental to the lower blocks of lifeboat tackles capsizing and fouling after the load is released, but obviously it will be found advantageous when fitted to any double or treble purchase, such as topping lifts. The difficulties and the seriousness of blocks capsizing and fouling always experienced with lifeboat gear is well known. This simple anti-fouling device overcomes these troubles. Not only is it most desirable to have the tackles and blocks clear for rounding up for the purpose of getting another boat under way from the same davits when required but it is of great importance to have the blocks clear for quickly hooking onto a returning boat, especially in a seaway or in a tide-way when delay in this respect may prove more or less fatal. The device is made of galvanized iron and its design is such that the rope falls will not chafe. It is claimed for the device that it absolutely prevents fouling, keeps the blocks clear and in a vertical position in readiness for quickly hooking on and that they will remain so until the boat is hoisted inboard.



NON-TOPPLING BLOCK.

THE BARK HESPER

Bark Hesper in Commission

So urgent appears to be the demand for tonnage on the Pacific coast, especially in the lumber trade, that the old wooden American bark Hesper, now under the Peruvian flag, which has been lying idle on Puget Sound for the past four years, has been placed in commission. She will carry a cargo of lumber from Gray's Harbor to Valparaiso. Capt. Fred Hackett, who bought the Hesper two years ago, will sail her.

Trials of Torpedo Boat Destroyer Beale

The torpedo boat destroyer Beale, built by Cramp's, Philadelphia, recently underwent her trials with the following results:

Trial.	Average Speed.	Average R. P. M.	Av. shaft H. P.
4-hr. full speed.	29.649	783.28	11,800
4-hr. 25-knot....	25.000	617.14	6,250
4-hr. 16-knot....	16.346	380.785	1,345
Average five highest standardization runs	32.235	904.42	15,158.4

The Fumigating & Fire Extinguishing Co. of America, 29 Broadway, New York, has received an order from Dr. Guiteras, Cuban government health officer, for two sets of their apparatus, for shipment to Havana.

Personals

Admiral F. T. Bowles, president of the Fore River Ship Building Co., has been seriously ill, but is convalescing.

F. J. McDonald, president of the Philadelphia Ship Repair Co., has returned from a trip to Europe greatly benefited in health.

E. C. Felton, president of the Pennsylvania Steel Co., does not think that the extension of American register to foreign-built ships engaged in foreign trade would have any practical results, owing to the increased cost of operation which such register entails.

Prof. Herbert C. Sadler, of Ann Arbor University, has been requested to teach a post graduate course in marine engineering at the Naval Academy at Annapolis for a few months. He will undertake the work immediately.

The Royal Mail Steam Packet Co. has ordered four new 650-ft. passenger steamers for Panama canal traffic.

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These boilers hold the record for economy, capacity and endurance in the Navies of the World.

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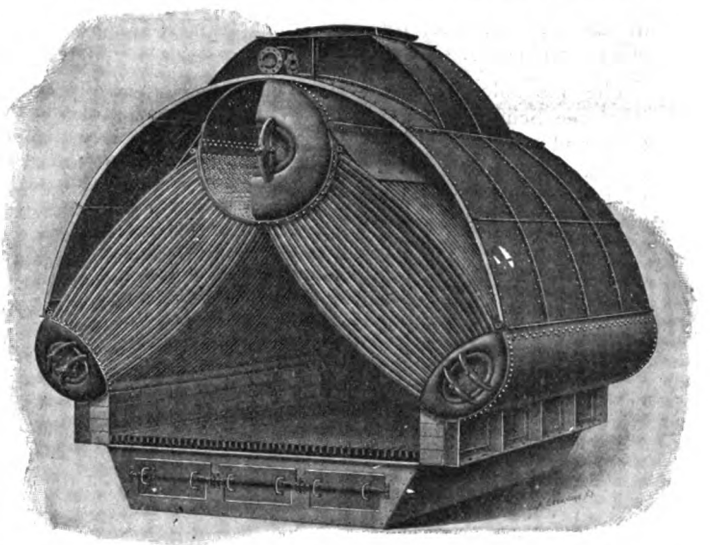

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Scherzer Rolling Lift Bridge for England

One of the principal bridge building contracts of the year has just been placed by the Great Central Railway of England, with Sir William Arrol & Co., Ltd., of Glasgow, Scotland, for the construction of a large new railway and highway Scherzer rolling lift bridge and approaches across the River Trent, at Keadby, in Lincoln, England. The requirements of navigation at this point on the River Trent, just above where it enters into the River Humber, are quite severe and necessitated the most careful consideration in selection of the type of draw span, and the engineers of the railway company visited all of the important modern movable bridges in Great Britain and America before deciding upon the Scherzer type as best fulfilling the requirements of navigation and the very heavy traffic over the bridge.

The structure will be composed of two fixed approach spans in addition to the bascule span and the track girder span upon which the moving leaf rolls in its operation, on the well-known simple Scherzer principle. The total length of steel work will be nearly 500 feet. Each span will have three trusses, the center truss dividing the railway and roadway portions of the bridge deck. The railway section will have a width of 29 ft. and the roadway 24 ft. center to center of trusses.

The movable span of this bridge is of the Scherzer single leaf through type and as it will have a movable length of 160 ft. and an extreme width of nearly 60 ft. it will be one of the largest bascule bridges in the world. The machinery and power equipment designed for opening and closing the bridge in one minute is very simple and effective for so large and heavy a structure. The power will be electricity generated in a machinery house alongside the bridge and this current will actuate the motors which are placed on the rear end of the movable leaf. These motors are geared to the main operating shafts which drive pinions engaging with racks on independent fixed supports outside of the plane of the movable bridge trusses. This method of operation is one of the special features of the latest designs of Scherzer rolling lift bridges, and reduces the machinery and power required to a minimum even in the largest and heaviest structures.

The sub-structure will consist of steel caissons carried to about 50 ft. below the low water of ordinary spring tides and the masonry piers carrying the superstructure will be founded upon these caissons.

The entire bridge is designed in accordance with the latest practice in both foundations and steel structures to carry the heavies main line traffic of the Great Central railway between Doncaster, Grimsby and the large modern Immingham Docks on the Humber river.

Sir. William Arrol & Co., Ltd., will execute the work under the supervision of J. B. Ball, engineer in chief of the Great Central Railway Co., London, by whom the foundations and approach spans were designed. The Scherzer Rolling Lift Bridge Co., Chicago, Albert H. Scherzer, president and chief engineer, designed the superstructure, operating machinery and power equipment of the bascule span, and will maintain a general consulting engineering supervision over the manufacture and erection of that portion of the work in co-operation with Mr. Ball's staff.

Relation of Horse Power to Kilowatt

There was, before 1911, no precise definition of the horsepower that was generally accepted and authoritative, and different equivalents of this unit in watts are given by various books. The most frequently used equivalent in watts, both in the United States and England, has been the round number, 746 wats; and in 1911 the American Institute of Electrical Engineers adopted this as the exact value of the horsepower. It is obviously desirable that a unit of power should not vary from place to place, and the horsepower thus defined as a fixed number of watts does indeed represent the same rate of work at all places. Inasmuch as the "pound" weight, as a unit of force, varies in value as the acceleration of gravity varies, the number of foot-pounds per second in a horsepower accordingly varies with the latitude and altitude. It is equal to 550 foot-pounds per second at 50° latitude and sea level, approximately the location of London, where the original experiments were made by James Watt to determine the magnitude of the horsepower.

The "continental horsepower," which is used on the continent of Europe, differs from the English and American horsepower by more than 1 per cent, its usual equivalent in watts being 736. This difference is historically due to the confusion existing in weights and measures about a hundred years ago. After the metric system had come into use in Europe, the various values of the horsepower in terms of local feet and pounds were reduced to metric units and were rounded off to 75 kilogram-meters per second, although the original English value was equivalent to 76.041 kilogram-meters per second. Since a unit of power should represent the same rate of work at all places, the "continental horsepower" is best defined as 736 watts, this is equivalent to 75 kilogram-meters per second at latitude 52° 30′, or Berlin. The circular gives tables showing the variation with latitude and altitude of the number of foot-pounds per second and of kilogram-meters per second in the two different horsepowers.

These values, 746 and 736 watts, were adopted as early as 1873 by a committee of the British Association for the Advancement of Science. The value, 0.746 kilowatt, will be used in future publications of the Bureau of Standards as the exact equivalent of the English and American horsepower. It is recognized, however, that modern engineering practice is constantly tending away from the horsepower and toward the kilowatt. The Bureau of Standards of the Department of Commerce and Labor and the Standards Committee of the American Institute of Electrical Engineers recommend the kilowatt for use generally instead of the horsepower as the unit of power.

Sperry Gyroscopic Compass

The Sperry Gyroscope Co., 74 Broadway, New York, recently issued a catalog descriptive of the latest developments of the gyroscopic compass. These compasses are now being installed upon all of the large battleships of the United States navy and on submarine classes E., F., G., and H. In addition to having a very high directive power and being an instrument of great precision, the gyroscopic compass is the first in the world to point true north undeviatingly and continuously under all conditions of service. It is well known that the magnetic compass is variable, never pointing true north, and being especially inconstant upon steel ships. It is stated upon competent authority that the Sperry gyroscopic compass is the first that has been produced which stands on the meridian without correction or calculation under service conditions, no other gyroscopic compass existing which does not have a serious deflection factor.

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